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KUSTOM'S

Road Runner

HAND-HELD TRAFFIC RADAR

MAINTENANCE MANUAL

P/N 006-0346-00

KUSTOM ELECTRONICS INC.
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316/431-2700

MP MASTER
MA35535

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INTRODUCTION

This maintenance manual has been designed for one purpose--to give you, the technician, all the latest written and visual information you will need to keep your equipment in good working order. Any new data deemed necessary will be provided to you as our obligation to update this material.

We have made an effort to present this material in a manner that provides all the data you need for problem solving in one concise area.

Except as provided in the terms and conditions of the sale/lease agreement, Kustom Quality Electronics, Inc. makes no other warranty, expressed or implied. Warranty service and repairs must be performed by qualified persons at an authorized Kustom Service Center or the units to be serviced must be returned to the factory.

GENERAL INFORMATION

MATERIAL SUPPLIED

The units and accessories supplied with a RoadRunner standard order are listed below:

Part No.	Description
064-0048-20	RoadRunner radar unit
006-0345-00	Operator's Manual
047-5000-12	50 MPH K-Band tuning fork

Optional Accessories

065-0025-00	7-inch dash mount
065-0021-00	12-inch dash mount
035-0034-00	Heavy duty carrying case
015-0001-01	Battery pack
155-2127-00	Auxiliary receptacle & shielded cable
065-0020-00	Holster
065-0020-01	Holster with seat bracket
047-5000-xx	Tuning forks for various speeds (Please specify speed desired)

TECHNICAL SPECIFICATIONS

MICROWAVE

Frequency:	24.15±.1 GHz (K-Band)
Output Power:	12 mW typical, 40 mW max.
Source:	Gunn-effect diode
Antenna type:	Conical horn
Polarization:	Right-hand circular
3 dB Beamwidth:	12°±1°
Antenna Gain:	Approx. 23 dBi
Power Density:	0.31 mW/cm^2 typical, 1.08 mW/cm^2 max (measured at face of antenna)
Receiver Type:	Low-noise Schottky barrier diode

COUNTING UNIT

Operating Voltage Range: 10.8 VDC-16.5 VDC, 13.6 VDC nominal

Nominal Power Rqmts:

	Voltage (VDC)	Current (A)
With displays illum:	13.6	0.7
Without displays illum:	13.6	0.3
With target present:	13.6	0.4
Without target present:	13.6	0.3
Standby (HOLD):	N/A	N/A

Operating Temperature/ Humidity: -20°C to +60°C; 90% relative humidity at 37°C, non-condensing.

Target Speed Range: 20 to 90 MPH within 10 dB Target Channel sensitivity; typically 15 to 199 MPH over a broader sensitivity range.

OPERATION AND THEORY OF OPERATION

OPERATION

Preparation for Use

Unpacking the Radar

The RoadRunner has been shipped in a formed foam packing material and heavy-duty container to prevent damage. Inspect this container and the contents for damage immediately upon arrival.

NOTE: Formed foam packing materials and containers should be retained and stored for possible reuse.

Be sure to check the contents of your order against the list of Materials Supplied on P. 2.

Power Source

Cigarette lighter receptacles are the traditional power source for traffic radar. However, in some cases, it is possible that poor grounding, electronic ignition bleedover, and alternator noise in newer cars can combine to create an unacceptably high level of ambient electronic interference. Symptoms of such interference include abnormal noise or tones heard in the audio and/or decreased range.

If radar operation is degraded by the electrical interference present in the vehicle, it is recommended that a two-conductor shielded cable, available from Kustom, be installed as directed below. An optional battery pack may be utilized for non-vehicular operation.

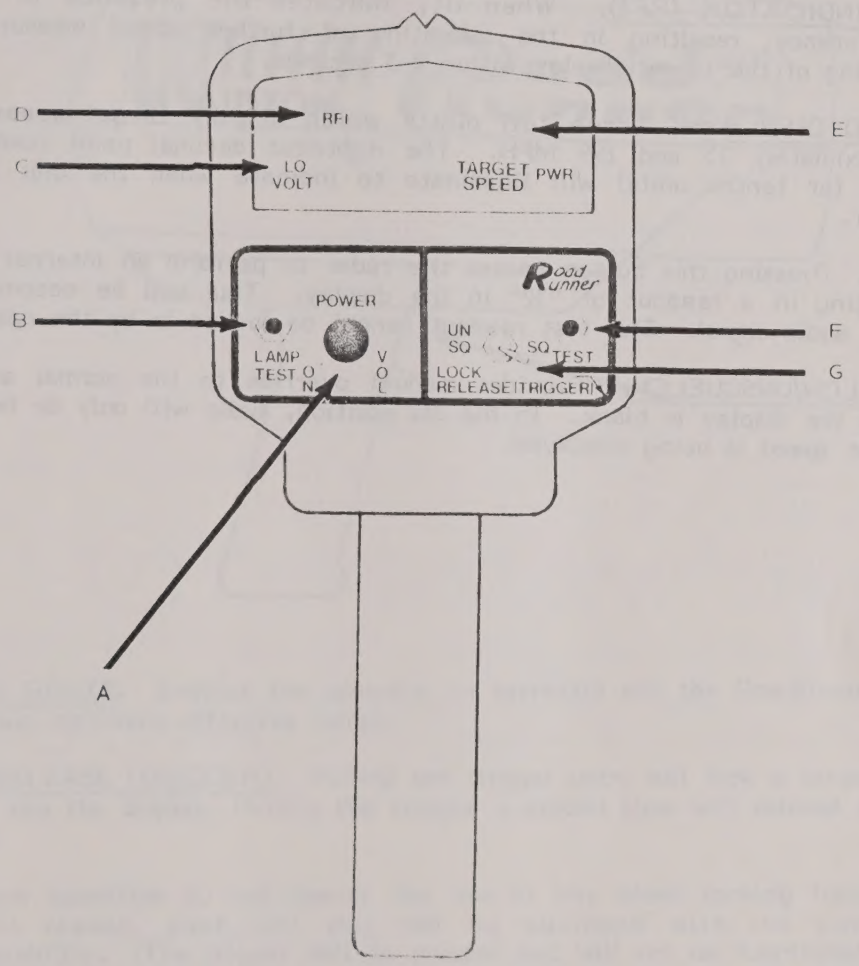
To install the power outlet cable assembly: Mount the receptacle under the dash or other desired location; the black wire should be grounded to the metal bracket. Run the cable to the battery; attach the white wire to the positive terminal, the black wire to the negative terminal. Ensure all attachments are firm and will not easily vibrate loose.

Heating and Ventilation

Conditions should be such that temperatures in the operating area of the RoadRunner do not exceed -20°C to +60°C (-4°F to +140°F) and operating humidity does not exceed 90% at 99°F.

Controls and Indicators

Rear View



A. POWER/VOLUME (PWR/VOL). Dual purpose control for ON/OFF and target Doppler audio volume. Turn the control clockwise to activate the radar and to adjust the level of the Doppler audio.

B. LAMP TEST. When the LAMP TEST button is pressed, the system will illuminate all display segments. The display will register "888" and the two LED indicators (LO VOLT, RFI) will light, indicating proper functioning of all lighting segments.

C. LOW VOLTAGE INDICATOR (LO VOLT). When lit, indicates battery voltage has dropped below 10.8 volts, resulting in the inhibiting of further speed measurements and blanking of the target display within 2-3 seconds.

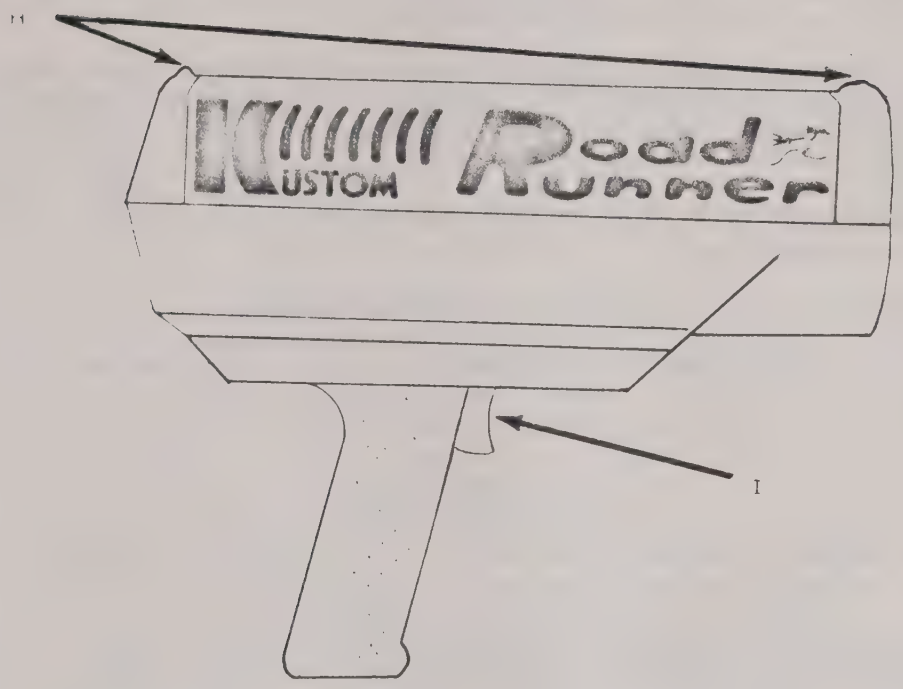
D. RFI INDICATOR (RFI). When lit, indicates the presence of strong RF interference, resulting in the inhibiting of further speed measurements and blanking of the target display within 2-3 seconds.

E. SPEED DISPLAY. Three full digits which display target speeds between approximately 15 and 199 MPH. The rightmost decimal point (center decimal point for tenths units) will illuminate to indicate when the unit is receiving power.

F. TEST. Pressing this button causes the radar to perform an internal circuit test resulting in a readout of "32" in the display. This will be accompanied by a brief audio signal. This test readout cannot be locked in by the operator.

G. SQUELCH/UNSQUELCH. Provides manual override to the normal audio squelch when the display is blank. In the SQ position, audio will only be heard while a target speed is being displayed.

Side View



H. AIMING SIGHTS. Enables the operator to correctly aim the RoadRunner antenna to obtain maximum effective range.

I. LOCK/RELEASE (TRIGGER). Pulling the trigger once will lock a target vehicle's speed into the display. Pulling the trigger a second time will release a locked-in speed.

NOTE: Some localities do not permit the use of any speed locking function. For this reason, your unit may not be equipped with the Lock/Release capability. (The trigger will be present but will not be functional.)

Test Sequence

For the purpose of assuring accuracy and introducing court evidence, it is recommended that the circuit test, light test, tuning fork test, and moving test be conducted at the beginning and end of each patrol shift.

1. Turn the PWR/VOL knob clockwise. Check the lower right corner of the display to ensure the Power Indicator is glowing. If the indicator does not come on when the PWR/VOL knob has been activated, recheck the connection to the power source.

2. Press the LAMP TEST button. The display should register "888" and both LED's on the left should light.

3. Press the TEST button. The display should register "32".

4. Conduct the tuning fork test as outlined in the Operator's Manual.

5. Conduct the Moving Test as outlined in the Operator's Manual.

Operating Procedure

Complete operating procedures are found in the RoadRunner Operator's Manual. They are briefly outlined below for your convenience.

1. Select squelched or unsquelched audio by moving the switch on the rear panel of the RoadRunner to the appropriate position.

2. Adjust the PWR/VOL control for comfortable listening to the Doppler audio.

3. If unit is equipped with the Lock/Release feature, locking may be done by pulling the trigger once. To release a locked-in speed, pull the trigger again.

THEORY OF OPERATION

General Description

The Kustom RoadRunner traffic radar transmits a continuous wave unmodulated radio frequency signal at a frequency of 24.150 Gigahertz. It utilizes the Doppler effect to measure the speed of vehicles traveling toward or away from it. The Doppler principle stipulates that relative motion between a target and the radar produces a change in the frequency of the reflected microwave signal that is proportional to the speed of the target. The radar measures this frequency change and displays the speed in miles per hour, kilometers per hour, or knots.

This principle may be understood by considering the situation of a stationary target which is located in the beam of a stationary radar. Since the signal must travel to the target and be reflected back to the radar, the distance is equal to $2R/\lambda$, where R is the range of the target and λ is the wavelength of the transmitted signal, and they are both measured in the same units. The total number of wavelengths correspond to the amount of time that is required for the signal to travel to the target and be reflected back to the radar. This appears as a fixed difference in phase between the transmitted signal and the received signal because both the radar and the target are stationary. Therefore, we can write $\emptyset = 2R/\lambda$

If the target is moving, the phase difference and the range are continuously changing with time. Since frequency can be defined as the time rate of change of phase, the change of phase that is produced when the target is moving becomes a frequency. This frequency is the Doppler frequency that adds to or subtracts from the transmitted frequency. A similar conversion can be made with the range, because velocity can be described as the time rate of change of distance, so the change of range with time becomes a velocity when the target is moving. If those conversions are applied to the previously developed formula, the following relationships are valid when the target is moving:

$$F_D = \frac{2V}{\lambda}$$

where F_D is the Doppler frequency,
V is the velocity of the target,
and λ is the wavelength of the transmitted signal

Since the wavelength of the signal is equal to its velocity divided by its frequency, the formula may be written:

$$F_D = \frac{2VF_O}{C}$$

where F_D is the Doppler frequency,
V is the velocity of the target,
F_O is the frequency of the transmitted signal,
and C is the velocity of light.

The Doppler frequency for one mile per hour of target velocity may be determined from this formula if the velocity of light is given in miles per hour.

$$F_D = \frac{2 \times 1 \times 24.15 \times 10^9}{6.70617 \times 10^8} \quad \frac{\text{MPH-Hz}}{\text{MPH}}$$

$$F_D = 72.023 \text{ Hz}$$

Therefore, a frequency change of approximately 72 Hz is produced by each mile per hour of velocity that the target is moving.

The target velocity used in the formula represents movement in a straight line and directly towards or away from the radar. It is not always possible to be in this straight line in actual operation. The error that is introduced by not aiming the radar directly in the target path may be evaluated by writing the velocity in terms of the angle made between a direct line from the radar to the target and the target path.

$$V_A = V \cos \theta$$

where V_A is the apparent velocity,

V is the true velocity,

and θ is the angle between the target path and a straight line from the radar to the target.

It is evident from this that the speed the radar reads will always be less than the true speed of the target as the angle is increased (for stationary radar). When the angle is zero degrees and the radar is aimed directly in the target path, the apparent velocity is the maximum and there is no error introduced, but as the angle increases to ninety degrees, the apparent velocity decreases to zero.

Circuit Theory

Microwave Assembly (200-0373-91)

One antenna is used to both transmit the microwave energy and receive the reflected Doppler signal. This is possible because these two signals are always at different frequencies when a moving target is present. The transmitted signal must be isolated from the received signal, however, to prevent large amounts of power from being introduced into the receiver circuitry and damaging it. Any noise that is generated by the transmitter must also be isolated from the receiver to prevent it from degrading the performance of the receiver. A balanced duplexer using a turnstile junction that employs circularly polarized waves is used to accomplish the required isolation. The result is that the antenna radiates a left-hand circularly polarized wave that is reversed by the target to a right-hand circularly polarized wave, which is the received signal. A solid state Gunn-effect oscillator is placed on one port of the duplexer and generates the microwave signal that is transmitted. A mixer composed of a Schottky diode in a tuned mount is placed on another port of the duplexer and acts as the input to the receiver.

The Doppler signal is recovered by homodyning the reflected signal with the transmitted signal in the mixer diode. A portion of the transmitted signal from the Gunn diode transmitter is supplied to the mixer by leakage through the duplexer. The reflected signal, by virtue of its polarization, is directed to the mixer diode. A difference of the two signals is produced in the mixer diode. This is the Doppler signal. The reflected signal is higher in frequency than the transmitted signal if the target is approaching and lower in frequency if the target is receding. The mixer diode produces a difference of the two signals that is the same in either case, however, and the direction that the target is moving is lost in the detection process.

A coaxial lowpass filter is used on the mixer diode mount to effectively seal the waveguide and allow the audio signal to be removed from the diode through a coaxial cable.

Stationary targets that are located in the beam of the radar produce a DC voltage across the mixer diode. A coupling capacitor isolates this DC component from the input to the preamplifier.

Preamp/Filter Board (200-5657-20)

The Preamp/Filter Board takes the Doppler audio from the mixer diode and filters and amplifies it to an 8-Volt square wave to be sent to the counting circuitry on the Logic Board.

The low-level Doppler signal enters the Preamp/Filter Board through a phono plug and is then filtered by the pi-network consisting of L1, C4, and C5 to remove all RF. The mixer diode is biased by R3 and R4 and overload protected by CR1 and CR2. The audio signal is then AC-coupled through C3 to the low-noise preamp consisting of Q2, Q3, and Q4 and associated components. AC coupling is used because stationary targets in the beam of the radar produce an undesired DC voltage across the mixer diode. C2, C17, and C19 provide additional high-frequency bypassing. R21 isolates signal and chassis grounds and R1 and C1 provide 8-Volt filtering. R2, R18, R19, R22, and R24 are bias resistors. R20, R23, and C15 form the feedback network establishing the preamp AC gain at about 40 dB. There is no DC gain due to C15. C14 and C16 are frequency-compensating capacitors. C3, C15, and C18 limit the preamp frequency response to approximately 10-200 MPH. U5B and associated components form a high-pass filter with a corner frequency of approximately 800 Hz (10 MPH). R38, R39, and C21 form a +4-Volt reference for the filter and other circuitry. U8B, U5A, U8A, and U6A form two identical AGC stages, each of which is capable of providing approximately 0 to 40 dB of gain. U7B acts as a detector whose DC output increases with increasing AC input. U3A filters the detected output to remove the fundamental AC component. As the AC input to U7B increases, more current flows through R44 and R59, reducing the gain of U8A and U8B, thus AGC action is achieved. U5A and U6A act as current-to-voltage converters and as buffers to U8A and U8B. To compensate for offsets and bias currents within U8B, DC feedback is provided by R56, R57, R60 and C49. Likewise, U8A utilizes R41, R42, R62, and C36.

U6B and associated circuitry form a low-pass filter with a corner frequency of approximately 14 KHz (200 MPH).

The AGC amplifier stages are followed by a comparator, U3B, which squares the Doppler wave into logic levels. U3B then passes the digital Doppler signal to the Logic Board.

Logic Board (200-5656-20)

The target speed signal, coming from the Preamp/Filter Board, is switched through U18 to the phase lock loop (PLL), U16, used for determining signal quality. As the phase lock loop corrects its loop voltage to match the incoming target speed frequency, error correction pulses are generated and U5B detects those pulses and holds the line quality high, not allowing the radar to count. When the PLL is on frequency, the correction pulses are not present, allowing the quality delay circuit, R11, C9 to time out. At the end of this 22 msec period, if the signal is still good, the quality signal at U2 Pin 8 is allowed to go high, allowing a speed measurement. If the signal goes bad at any time, the quality line rapidly goes back low, inhibiting further speed measurements.

The quality, RF1, and low voltage signals, along with the update one-shot output from U8B are gated by U6A to determine if speed measurements may be made. When U8B calls for another update count, all three signals must be high before the time base is allowed to count the incoming Doppler.

The time base is generated by a crystal-controlled oscillator, U1B. This oscillator is then divided down by U15 and U10B to form an accurate 13.88 millisecond timing window for MPH units, or 22.34 millisecond timing window for KM/H units. When the PLL is locked to the incoming signal, quality goes good and U11B flip-flop is released from a forced set waiting for the next positive edge of the incoming target signal from gate U18C and inverter U1C. When the edge is received, U11B is reset, releasing the reset lines on dividers U15 and U10B, as well as the target counters U14A, U14B, and U12B. After 32,768 clock pulses, U10B Q_4 goes high and on the next clock pulse, flip-flop U11A is set, causing U18C to gate off the target speed signal and triggering the blank/display one-shot U8A and update flip-flop U8B. The update flip-flop determines the interval between timing windows by holding the output of U6A high until U8B times out. U8A determines the length of time the target reading will be displayed, provided it is not retriggered with a new timing window which starts its time-out period over again.

U9 is a crystal-controlled oscillator and frequency divider on one chip. The divided frequency is fed to U18B. When the TEST button is depressed, U18A,B, and D switch from the incoming target signal to the internal divided frequency generated by U9. This signal is routed to the PLL and counting circuitry and the radar should display "32" until the TEST button is released.

U2B and U17A comprise the Lock/Release circuitry. When the trigger is pulled, the lock line is pulled low. R16, R15, and C13 form a delay network to eliminate switch bounce. This signal is then inverted by U2B and applied to the clock input of U17A flip-flop. When the clock input goes high, multivibrator U1D and U5C is enabled. This low frequency signal is gated through U7C to flash the displays, indicating a locked speed. Quality is inhibited during lock by U17A and CR5.

The target speed signal is also fed to a divide-by-four counter, U10A. This counter is gated off and on with the blank/display one-shot U8A. When the one-shot is in the display mode, the counter is allowed to pass the divided Doppler through to the audio amplifier, but in the blank mode, the divider is turned off or "squelched".

Transistors Q1 and Q2 comprise a current amplifier to drive the speaker with the target Doppler signal.

U2A and associated circuitry form a power-up reset network which resets the lock flip-flop and resets the display one-shot when power is applied.

In the squelch mode, when there is no display, Pin 1 of U10A audio divide-by-four stage is held high by the blank/display one-shot. When a target is present, the display one-shot fires, pulling Pin 1 of U10A low, allowing the divider to divide the Doppler by 4 and pass this signal on to the audio amplifier. When the SQUELCH/UNSQUELCH switch is placed in the UNSQUELCH position, Pin 1 of U10A is pulled low, allowing the divider to operate even when there is no target present.

U12A is an extra divider used only on tenths units to synthesize the U16 VCO to run at ten times the incoming Doppler frequency. On the tenths units, U12A is inserted between Pins 3 and 4 of U16.

Rear Panel Controls

Audio level control R101 and Power On switch S101 are on the same control. R101 varies the amplitude of the target speed signal going to the audio amplifier and speaker, and SPDT switch S101 breaks the +12 Volt line coming from the cigarette lighter plug to turn the unit off.

The LAMP TEST switch, S105, is a momentary switch, which, when depressed, causes the 7-segment displays and all functional lights to illuminate. The LT line is connected to U2, a quad 2-input NOR gate, and each of its two outputs drives a 2N3567 transistor, which is the driver for either the RFI or LO VOLTAGE lamps. The LT line also directly connects to each of the display driver's L/T pins.

The TEST switch, S103, is a momentary switch which pulls the test line low when depressed. This line controls whether the Logic Board sees the target speed Doppler frequency or the internal test frequency. Depressing S103 will result in "32" being displayed when the unit is operating properly.

Switch S102 is a SPDT switch which allows the operator to switch the radar from a squelched condition (allowing audio only when the unit is displaying a reading) to an unsquelched condition, allowing constant audio. This switch takes the squelch line low in the unsquelched mode, causing the audio to turn on even if there is no target present.

Power is brought into the unit through a hash and RF filter composed of a pi-section filter C102,C104, and R103, followed by a feed-through capacitor, C103. The cigarette plug is internally fused and series diode CR103 prevents any damage to the radar due to reverse voltage. CR103, C102, C103, C104, and R103 are all contained in a shielded housing mounted in the handle of the radar unit.

Interconnect Board (200-5659-20)

The Interconnect Board contains five main sections, as well as providing all of the interconnects for the radar unit. The five sections are: The microwave power supply, 8-Volt regulator, RFI detector, low voltage detector, and functional light drivers.

The microwave power supply consists of U1 and associated circuitry. U1's internal reference voltage is divided by R1 and R2, filtered by C6, and applied to the noninverting input of the 723. Feedback is accomplished by divider R4, variable resistor R3, and R5 and is fed to the inverting input where is is compared to the divided reference voltage. The output voltage can be adjusted over a +3 to +7.5 Volt range. Greater current capacity is provided by pass transistor Q6 and limited to about 3 Amps by resistor R7.

U4 provides +8 Volts to the radar unit.

The RFI detector consists of U3B, CR5, CR6, C10, C12, C11, L1, R24, R25, and R26. U3B is half of a voltage comparator whose inverting input is biased slightly less than the non-inverting input. When an RF signal, coupled through C12, is detected by CR6 and C10, it lowers the voltage at the non-inverting input. If the signal is strong enough, the detected voltage will lower the non-inverting input below the inverting input reference voltage, driving the comparator output low, which will turn on the RFI lamp and blank the displays. CR5 and CR6 are matched diodes on a common substrate to allow better tracking over temperature.

The low voltage detector consists of U3A, CR2, R20, R21, R22, and R23. R21 and Zener diode CR2 provide a +3.3 Volt reference for the voltage comparator U3A. R20 and R23 form a voltage divider so that when the incoming voltage drops below 10.8 Volts, the voltage on Pin 3 drops below the 3.3 Volt reference on Pin 2, causing the output to go low, lighting the LO VOLT light and blanking the displays.

Two status lights are provided on the RoadRunner to indicate to the operator the current operating conditions of the unit. Each of the lights is driven through a current-limiting resistor by a 2N3567 transistor. The transistors are driven by U2, a quad two-input NOR gate. As the appropriate signal line goes low, the gate switches on, turning on the transistor, which applies voltage across the LED lamp.

Display Board (200-5658-20)

DS1, DS2, and DS3 form the target speed display, with U1, U2, and U3 being their BCD-to-seven-segment decoder/drivers, respectively. CR2 and CR3 are the RFI and LO VOLT LED lamps, respectively. R1 is used to turn on the appropriate decimal point as a "Power-On" indicator. For the standard MPH unit, the decimal point to the lower right of the least significant digit would be selected. For a tenths unit, R1 would be placed in the proper position to select the decimal point to the lower right of the second most significant digit.

MAINTENANCE

INTRODUCTION

The maintenance section includes: Bench set-up information, a step-by-step check-off list, and a problem/repair table. This information should help you cut down on the amount of time and effort normally involved in locating and repairing a problem area.

When you do need to go to a specific board for repair, the assembly drawing and schematic for that board are placed together for your convenience.

BASIC LOGIC REVIEW

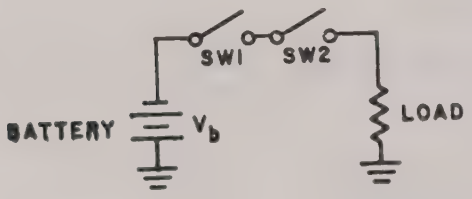
This review is a brief discussion of common symbols and terms used to explain some of the basic logic functions.

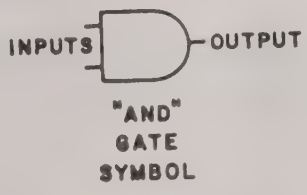
The RoadRunner radar system uses positive logic. Positive logic refers to the use of a 1 to represent the true or more positive level and 0 to represent the false or less positive level (0 Volts). A convenient method of converting the HI-LO logic convention to 1-0 notation is to disregard the first letter of each state. Thus:

HI = 1
LO = 0

The basic logic circuit is the AND gate. The AND gates contain two or more inputs and a single output. The output of an AND gate is HI only when all of the inputs are HI. A LO signal on any input terminal produces a LO signal output.

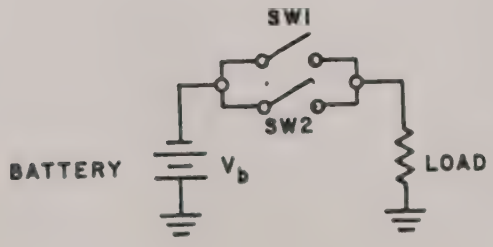
The circuit below illustrates the function of an AND gate. Both SW1 and SW2 must be closed before a voltage will be applied to the load.

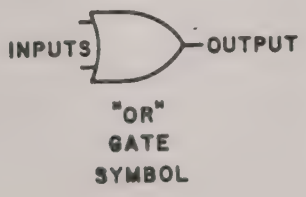




SW1	SW2	LOAD
OFF	OFF	0
OFF	ON	0
ON	OFF	0
ON	ON	V_b

A second basic logic circuit is the OR gate. OR gates contain two or more inputs and a single output. The output of an OR gate is HI when one or more inputs are at the HI state. The circuit drawing illustrates the function of an OR gate. If SW1 or SW2 or both switches are closed, the voltage will be delivered to the load.





SW1	SW2	LOAD
OFF	OFF	0
OFF	ON	V_b
ON	OFF	V_b
ON	ON	V_b

Logic diagrams make extensive use of a LO state indicator. A small circle at the input or output of a symbol indicates that the LO state is the significant state. The absence of a circle indicates that the HI state is the significant state. Below are two circuit illustrations:

A	B	X
LO	LO	LO
LO	HI	HI
HI	LO	LO
HI	HI	LO

A	B	X
LO	LO	HI
LO	HI	HI
HI	LO	LO
HI	HI	HI

A third device is the inverter amplifier. It is used to invert the sense of the signal. The inverter amplifier has one input and one output.

A	X
LO	HI
HI	LO

A NOR gate is functionally equivalent to an OR gate followed by an inverter. The NOR gate fulfills the logical function of producing a HI at the output only when all the input signals are simultaneously LO.

A	B	X
LO	LO	HI
LO	HI	LO
HI	LO	LO
HI	HI	LO

A NAND gate is functionally equivalent to an AND gate followed by an inverter. The NAND gate performs the logical function of producing a LO at the output only when all the input signals are HI.

A	B	X
LO	LO	HI
LO	HI	HI
HI	LO	HI
HI	HI	LO

TEST EQUIPMENT REQUIRED BY SERVICE CENTERS

To be adequately equipped to service Kustom radars, the following equipment is necessary:

POWER SUPPLY. Well-regulated, voltage-adjustable, current-limited, 2 Amp minimum, supplying 13.8 VDC. NJE Corp. Model LVX-11-20-2, or equivalent.

VOLTMETER. Fluke Model 8600A digital multimeter, or equivalent.

OSCILLOSCOPE. Bandwidth minimum 50 MHz, 7 ns rise time. Tektronix type 453 or equivalent.

SIGNAL GENERATOR. Hewlett-Packard 651B test oscillator, or equivalent.

SIGNAL GENERATOR. Hewlett-Packard 204D test oscillator, or equivalent. (This unit is required for testing moving radar.)

The following equipment is not an absolute requirement, but would be very helpful:

ATTENUATOR SET. Hewlett-Packard type 350D or equivalent.

TEST CHAMBER. Used to determine range of antenna. Building instructions on next page.

If transmitter frequency measurements are to be made:

FREQUENCY COUNTER. Systron-Donner frequency counter, model 6054B or equivalent.

FREQUENCY METER. Hewlett-Packard K-532A (for K-Band measurements) or equivalent.

If transmitter L.O. power measurements are to be made:

POWER METER. Hewlett-Packard type 432A or equivalent.

K-BAND THERMISTOR MOUNT. Hewlett-Packard type K486A.

Test Chamber: K-Band

This can be built with the following equipment:

Diode Mount Assembly	200-0544-00
or	
Mixer diode,	007-6034-00
Diode mount, and	073-0119-02
Cable assembly	155-2045-00
Waveguide	047-5064-02
Horn	047-0589-02

Coaxial cable
Tin or aluminum foil
Wooden box
Microwave absorbing material (Ecco-Sorb or equivalent)
For information on this material, contact: Emerson and Cuming, Canton, MA
Telephone: (617) 828-3300

The recommended size of the test chamber is 6 to 8 feet in length, 2 feet in height, and 2 feet in width. The inside of the chamber or wooden box should be lined with tin or aluminum foil and then the microwave absorbing material. In the center of one end of the chamber, cut an opening about 6 1/2 inches in diameter. This opening is used to aim the antenna toward the other end of the test chamber. Mount the waveguide assembly inside the chamber, at the center of the end opposite the opening. (The waveguide assembly incudes the horn, waveguide, diode mount, diode, and detector mount cable assembly.) A coaxial cable is used to connect the detector cable assembly to a test oscillator (651B Hewlett-Packard or equivalent) for stationary radar, or two test oscillators and a 20 dB pad (refer to Test Procedure section) for moving radar.

An antenna that is known to be good from a previous road test is aimed into the test chamber. The test oscillator is set at approximately 3600 Hz and the signal level is increased until the radar reads out approximately 50 MPH. For stationary radar, this is all that is required. For moving radar, verify the 50 MPH and switch to the moving mode of operation. Set the second oscillator at approximately 8000 Hz and increase the signal level until the radar reads the difference in MPH (approximately 60). By using several different antennas, both good an short range, a more precise setting of the signal level on the oscillators can be obtained for determining good range.

The test chamber is not meant to eliminate the road test. It cannot duplicate the vibrations, engine noise, false readings, etc. found on the road. It is helpful in preventing a premature trip on the road by indicating that a radar will have short range regardless of road conditions.

TEST PROCEDURE

Bench Testing the RoadRunner Radar

Recommended Equipment

1. Power supply capable of 2 Amps at 13.8 Volts.
2. Test oscillator (signal generator), 651B Hewlett-Packard, or equivalent.
3. Oscilloscope, 453 Tektronix or equivalent.
4. Digital voltmeter, Fluke 8600A or equivalent.
5. Frequency counter, Systron-Donner 6054B or equivalent

RoadRunner Check-Off List

Before proceeding with bench repair, check the following--it may save you valuable work hours.

1. Get first-hand information about the problem--what's wrong?
2. Remove top cover of unit and check with sight and smell. Are there any burnt, broken, or loose parts visible? Are all the wires to and from the microwave intact and connected?
3. Remove each board and carefully check for specific small part damage.
4. Make sure the unit is clean and free of foreign material before replacing any board.
5. When replacing boards, check the pins on the mother board that will accept each board. Are they straight and making proper contact?
6. When boards are seated, check to make sure the bases of all boards are clear from all parts.
7. When you have completed these steps, go on to the bench test procedures.

Test Procedure

RoadRunner OFF

1. Ensure unit is OFF by turning PWR/VOL knob fully counterclockwise.

2. Check the 2 Amp Slo-Blo fuse in the cigarette lighter plug. For access to the fuse, remove the tip of the power plug by turning counterclockwise.

3. Connect the unit to 13.8V power supply source.

4. Set the SQ/UNSQ control to the SQ position.

RoadRunner ON

1. Turn unit on by turning PWR/VOL control clockwise.

2. Ensure power indicator in lower right corner of display is glowing.

3. Depress and hold the LT (Light Test) button on the rear panel of the unit. The number "888" should appear on the display and the two LED indicators (RFI, LO VOLT) should be lit. Release the LT button.

4. Depress and hold the TEST button on the rear panel. The number "32" should appear in the display. Vary the volume control from fully clockwise to fully counterclockwise (do not turn unit off), and verify that volume increases in clockwise direction.

   While holding the TEST button depressed, pull the LOCK/RELEASE trigger to verify that the "32" cannot be locked in. Release the TEST button.

5. With the volume control fully cockwise and no reading in the display, set the SQ/UNSQ switch to the UNSQ position and verify that audio is heard. Reset to the SQ position, and audio should disappear.

6. Remove radar's top cover. Disconnect the Gunn oscillator leads from the interconnect board.

7. Using the DVM, measure the +8V regulator voltage on the logic board (200-5656-20), U1 Pin 14 (+). Verify the voltage is between 7.76 and 8.24 VDC.

8. Connect the DVM across the Gunn oscillator connectors P1 (+) and P2 (-) on the interconnect board and adjust R3 as necessary to obtain proper voltage, as indicated on the Gunn oscillator unit, ±100 mV.

   Turn the radar OFF, reconnect the Gunn oscillator leads to P1 and P2, turn the unit back on, and verify the voltage is within ±100 mV of the previous reading.

9. Place the radar unit in front of the receiving horn of the frequency counter and verify that the transmitter frequency is between 24.050 and 24.250 GHz.

Operational Tests

1. Connect U2 Pin 6 on the logic board (200-5656-20) to a 10 MHz frequency counter using a X10 scope probe and verify that the Y1 crystal reading is between 1.179906 MHz and 1.180142 MHz for a MPH unit and 1.466318 and 1.466612 for a metric unit.

   Connect the probe to U9 Pin 9 and verify that the Y2 crystal reading is between 1.184533 MHz and 1.184769 MHz for a MPH unit and 1.472069 MHz and 1.472363 MHz for a metric unit.

2. Connect the signal generator to the input connector, J6, on the preamp/filter board (200-5657-20) and inject a 1475 Hz signal at -50 dBm. Verify a reading of 20 MPH. Reduce the amplitude until the display blanks, then slowly increase the amplitude until the 20 MPH reading reappears. Record this level.

   Set the generator for approximately 6520 Hz (90 MPH) and repeat the test above. Verify the difference in amplitude between the 20 MPH and 90 MPH signal is not greater than 10 dB.

3. Leave generator setting as in previous step and connect a DVM between the emitter of Q5 (+) on the preamp/filter board and ground.

   Slowly increase the amplitude and verify the emitter voltage increases with increasing amplitude to about 6 or 7 Volts. Record this level.

   Repeat the step above with generator setting of approximately 1475 Hz (20 MPH). The emitter voltage should increase with increasing amplitude. Record the highest DC level reached. It should be within ±300 mV of the level found in the previous step.

4. Inject a 721 Hz (+1,-0 Hz) signal (-50 dBm) and verify that the radar displays 10 MPH. Increase the frequency to 790 Hz (+0,-1 Hz) and verify that the radar displays 10 MPH. Increase the frequency to 14,370 Hz (±20 Hz) and verify a reading of 199 MPH. Slowly increase the frequency and ensure the unit blanks readings above 200 MPH.

5. Set the signal generator to approximately 3640 Hz (50 MPH) at -50 dBm. Slowly increase the DC power supply voltage to approximately 16.3 VDC, then decrease to 10.8 VDC (+0.0,-0.1 VDC) and verify that the LO VOLT indicator remains off and that there are no false readings.

   Reduce the DC voltage until the LO VOLT indicator is lit. The voltage should be between 9.5 and 10.8 VDC. Display should blank within 2-3 seconds after the indicator illuminates and should not register any false readings.

   Increase the supply voltage until the LO VOLT indicator turns off (about 1 Volt greater than that required to turn the indicator on). Reset the power supply voltage to approximately 13.6 VDC.

6. Using the 50 MPH signal, pull the trigger and verify that the display is flashing the 50 MPH reading at a rate of approximately 2-3 times per second. Verify the

audio is unsquelched by removing the 50 MPH signal and placing the SQ/UNSQ switch in the SQ position. Noise should still be heard from the speaker.

Pull the trigger. Display should blank and audio should squelch.

Inject the 50 MPH signal again. Remove signal and wait for display to blank. Pull the trigger; display should remain blank and should not recall any speeds.

7. Replace the top cover on the unit. Place the radar in front of a detector diode and horn assembly and modulate the diode with a 3640±20 Hz signal. When the 50 MPH reading is obtained, position the radar so that the display blanks, then move the radar toward the horn until the reading reappears on the display.

   Place the antenna of a CB transmitter (rated 4 Watts output) approximately 5 feet from the radar unit. Set the transmitter to Channel 1 and depress the PTT button on the microphone. Strike a 35 MPH tuning fork and place it in front of the microphone. The RoadRunner's RFI indicator should light and the display should blank after 2-3 seconds. There should be no false numbers displayed--the unit should either read 50 or be blank.

   Repeat the test above with the CB set to either Channel 23 or Channel 40 (the highest channel on the transmitter being used). Repeat the test using a 65 MPH tuning fork.

   Move the CB antenna to approximately 10 feet away from the radar unit and repeat the preceding tests. The RFI indicator should not light and no false numbers should be displayed.

Troubleshooting Guide

Problem	Possible Reason/Solution
Short range	Check filter board Reset source voltage Tighten loose horn Replace microwave assembly Check preamp/filter board for noise and gain
Spurious readings	Check preamp/filter board Check mixer diode
Dead	Check for blown fuse (replace only with 2 Amp Slo-Blo) Check for open power cord or bad connection Check transient suppressor diode on mother board
Excessive current (which blows fuses)	Remove debris from unit Check for shorted source Check transient suppressor diode on mother board
Incorrect segments or missing segments	Check displays Check display drivers Check for short or debris where display board fits into mother board
No TEST cycle	Check crystals Check switch
No cal with forks	Check microwave Check preamp/filter board Ensure correct forks used Ensure microwave plugged in properly
No TARGET	Check microwave assembly Check preamp/filter board Check logic board
No audio	Check speaker Check audio transistor

DRAWINGS

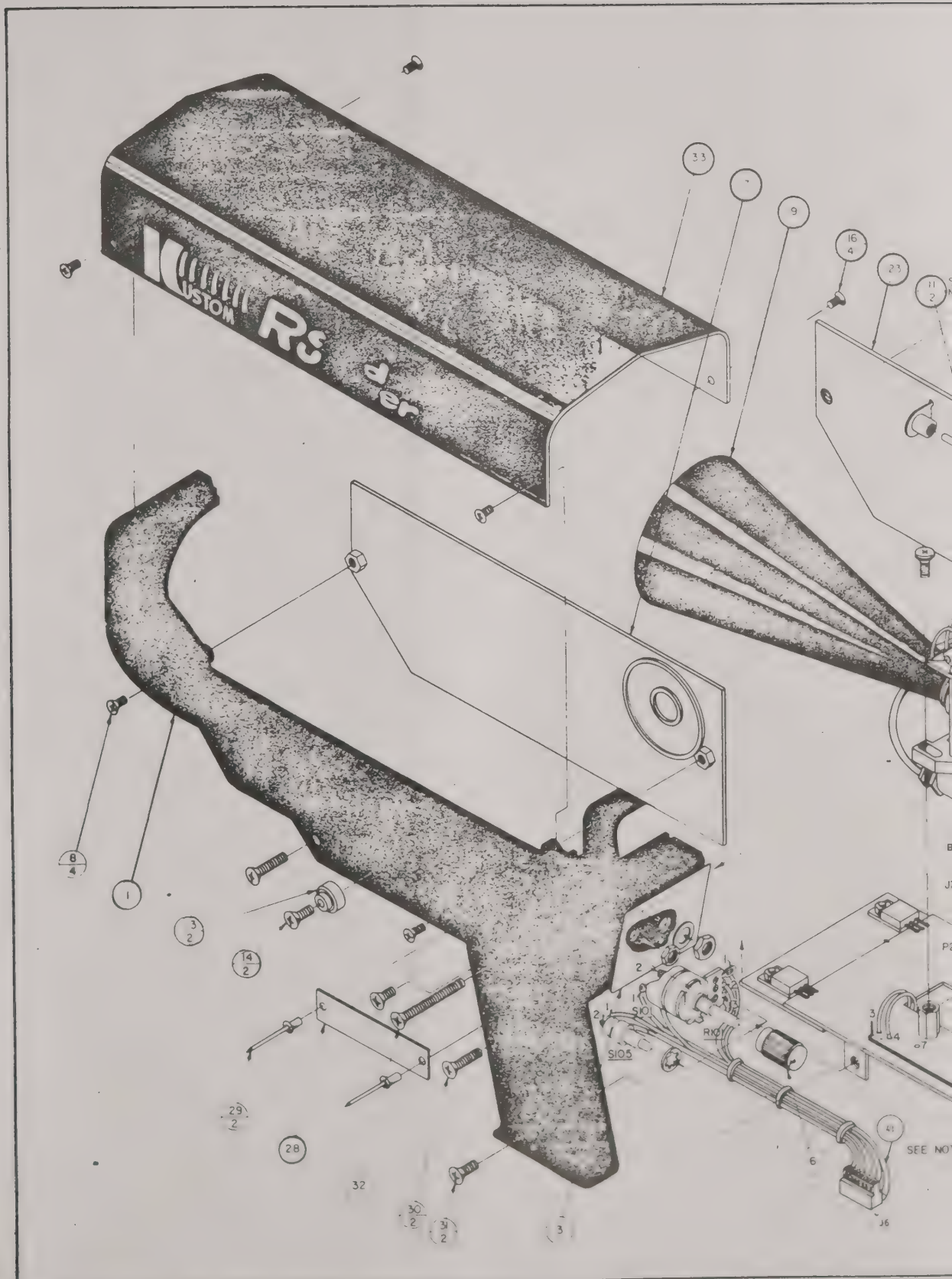
This section contains schematic diagrams and assembly drawings for the RoadRunner radar. They are arranged as follows:

Drawing No.	Description	Page No.
300-0336-20	Unit Assembly	31
300-0343-00	Trigger Bracket Assembly	33
300-0097-00	Microwave Assembly	35
300-5657-20	Assy Dwg Preamp/Filter Bd	36
002-5657-20	Schematic Preamp/Filter Bd	37
300-5657-21	Assy Dwg Preamp/Filter Bd	41
002-5657-21	Schematic Preamp/Filter Bd	42
300-5656-20	Assy Dwg Logic Bd	46
002-5656-20	Schematic Logic Bd	47
300-5659-00	Assy Dwg Mother Bd	50
002-5659-00	Schematic Mother Bd	51
300-5658-20	Assy Dwg Display Bd	54
002-5658-20	Schematic Display Bd	55

For your convenient reference, a parts list is included with the drawings for each assembly as well as in the Parts List section.

ASSEMBLY NO: 200-0884-20
DESCRIPTION: FINAL ASSY ROADRUNNER
ASSY DWG NO: 300-0336-20

REF NO	DESCRIPTION	PART NO
1,2	ROADRUNNER HOUSING PAIR	200-0957-00
3	REAR DECAL ROADRUNNER	057-1247-00
4(S103,105)	SWITCH PUSHBUTTON BLK	031-0122-01
5(R101,S101)	RESISTOR VARIABLE 10K LIN W/SW	133-0091-00
6	KNOB CONTROL	090-0036-00
7	LOGIC BD ROADRUNNER	200-5656-20
8	SCREW FHP 4-40 X 5/16 NLP	089-5538-01
9	HORN W/WAVEGUIDE	200-0373-11
10	MOTHER BD ASSY TSTD	200-5659-00
11	SCREW PHP 6-32 X 3/8 SEMS	089-5028-06
12	DISPLAY BD ROADRUNNER	200-5658-20
13	SLIDE SPACER	076-0235-00
14	SCREW PHP 6-32 X 1/2	089-5062-08
15	TRIGGER BRKT ASSY	200-0890-00
16	SCREW THP 4-40 X 1/4	089-5881-04
17	NOT USED	
18(S102)	SWITCH PUSHBUTTON BLK	031-0122-01
19-21	NOT USED	
22	SCREW PHP 6-32 X 1/4 SEMS	089-5028-04
23	FILTER BD ROADRUNNER	200-5657-20
24	TRIGGER	088-0090-00
25	LENS READOUT RED	087-1055-08
26	O-RING	187-0109-00
27	NOT USED	
28	S/N TAG LO PWR SOURCE	057-1198-01
29	POP RIVET	092-0000-32
30	SCREW OHP 6-32 X 1 1/2 SS	089-5801-24
31	SCREW OHP 6-32 X 3/4 SS	089-5801-12
32	SCREW OHP 6-32 X 2 SS	089-5801-32
33	COVER ROADRUNNER	047-0979-08
34-40	NOT USED	
41	CABLE ASSY	155-2470-00


33
9
16
4
23
11
2
8
4
1
3
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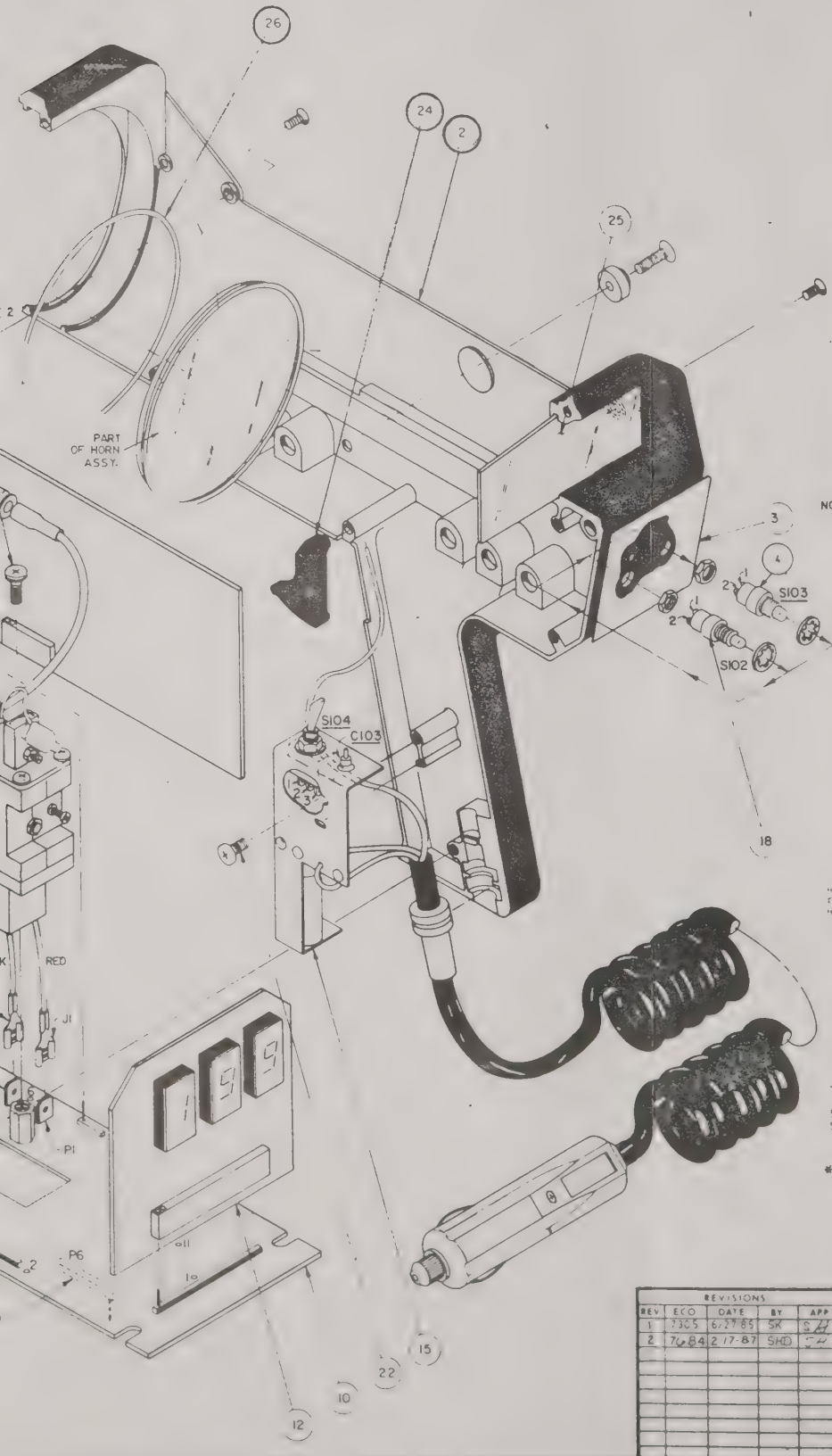
28
32
30
2
31
2
3
S101
S105
RK1
41
SEE NO
6
J6



B/M 200-0884-20

ITEM	QTY.	DESCRIPTION	P/N
1	1	ENCLOSURE GRY W/SEC DS FALCON	023-0135-05
2	1	ENCLOSURE GRY ROADRUNNER	023-0135-08
3	1	REAR SEAL, ROADRUNNER	047-1247-00
4	1	SWITCH PUSH BUTTON SUB A	[illegible]
5			
6	1	[illegible]	[illegible]
		[illegible] ROADRUNNER	[illegible] 20
		[illegible]	-5538-01
9	1	[illegible]	[illegible] -11
		[illegible] ROADRUNNER	[illegible] -00
11		[illegible]	[illegible]
12	1	[illegible] ROADRUNNER	[illegible] -20
13	2	[illegible]	[illegible]
14	1	[illegible]	[illegible] 08
15	1	[illegible]	0890-00
16	2	[illegible]	[illegible] 24
17			
18	1	SWITCH, PUSHBUTTON BLK	0122.01
19			
20			
21			
22		SCREW [illegible]	[illegible] -24
23	1	[illegible] ROADRUNNER	[illegible] -20
24	1	TRIGGER, HPR	[illegible] -00
25	1	LENS, READOUT	[illegible] -08
26	1	[illegible]	[illegible] -00
27			
28	1	SERIAL NUMBER TAG	057-4198-00
29	3	POP RIVET 3-3E DIA.	[illegible] -02
30	2	SCREW CHF 6-32 x [illegible]	[illegible] -24
31	2	SCREW CHF 6-32 x [illegible]	[illegible] -12
32	1	SCREW SHF 6-32 x [illegible]	[illegible] -12
33	1	TOP COVER, ROADRUNNER	[illegible] -08
34			
35			
36			
37			
38			
39			
40			
41	1	CABLE ASSY	155-2470-00
42	AR	LOCKTITE 242	046-0027-1

NOTES

1. (X) TOP DIGIT INDICATES ITEM NUMBER, (X) BOTTOM DIGIT INDICATES QUANTITY
2. ADD 'LOCTITE 242' (ITEM 42) TO ITEM 11
3. PLUG J6 TO P6 ON MOTHER BD (ITEM 10)

SEE 023-0006-xx [illegible] TO WIRE THE [illegible]

#WIRE FROM MOTHER BD.	TO	WIRE NO.	WIRE COLOR	DESCRIPTION	LENGTH
1	C103	8	Red	PWR	N/A #
2	S103-1	6	Brn.	TEST	5" ± .5"
3	S104-2	13	Org	LOCK/REL	N/A #
4	S102-1	11	Yel.	SQUELCH	8" ± .5"
6	Trigger Blk. Case	13	Blk.	GND	N/A #
7	Grn. Wire of Power Cable	15	Grn.	RF1	N/A #

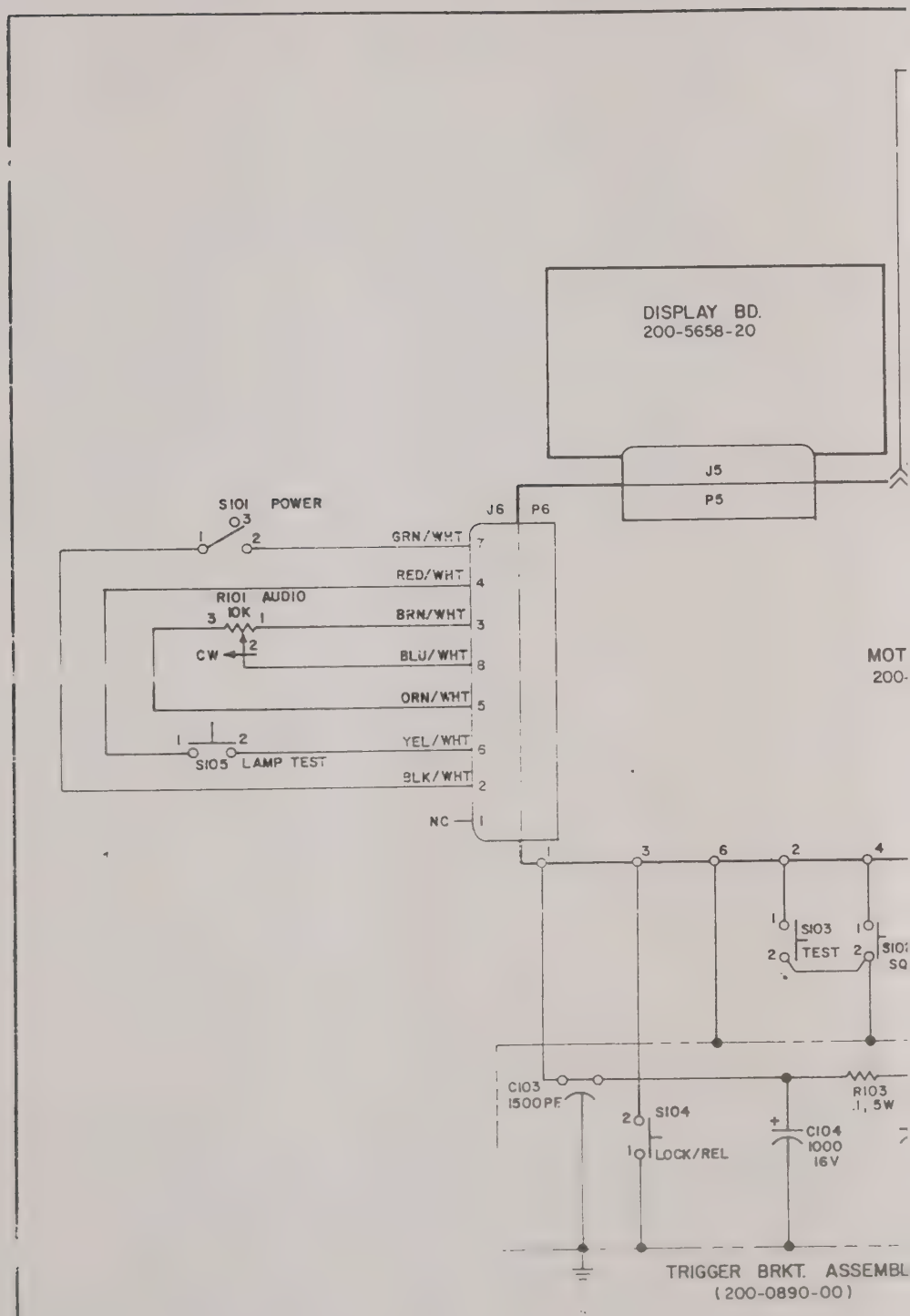
[illegible] 023-0006-10 BLK [illegible] TO WIRE [illegible] FOLLOWING

FROM	TO	WIRE NO.	WIRE COLOR	DESCRIPTION	LENGTH
S102-2	S102-2	14	Blk.	GND	2" ± .5"
S102-2	Trigger Bracket	2	Blk.	GND	N/A #

#WIRES ALREADY INSTALLED IN SUBASSY.

REVISIONS				
REV	ECO	DATE	BY	APP
1	7325	6/27/85	SK	[illegible]
2	7684	2-17-87	SHD	[illegible]

DRN Carl C	DATE 6/13	KUSTOM ELECTRONICS
CHK	DATE 1-84	
ENG	DATE 1-24	
TOLS UNLESS NOTED LINEAR [illegible] ANGLES ±1° HOLES [illegible] INCH [illegible]		TITLE FINAL ASSEMBLY
SCALE [illegible]	SHT 1 OF 1	UNIT ROADRUNNER
		P/N 300-0336-20 SIZE D

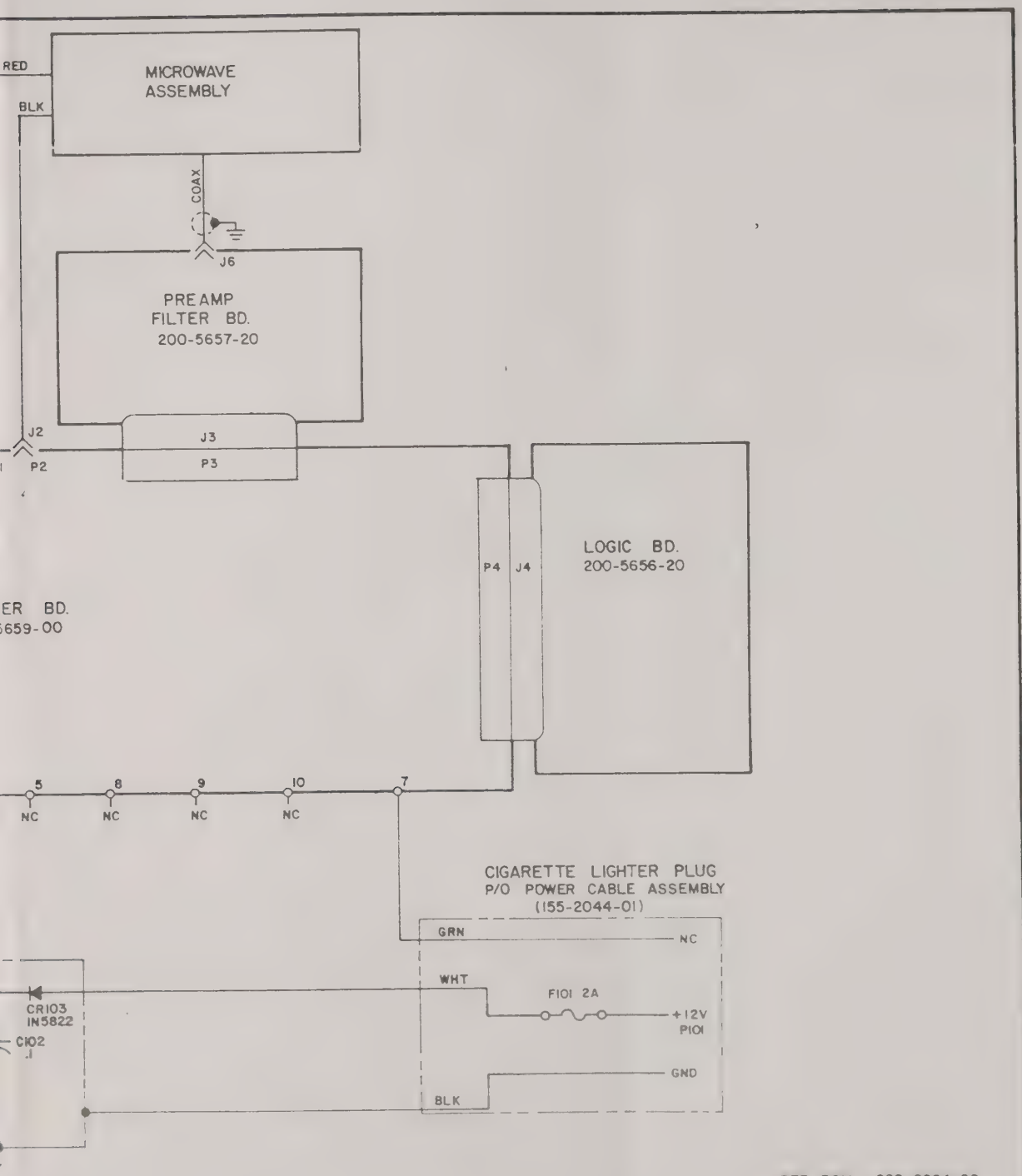


NOTES

1. ALL CAP VALUES ARE IN MICROFARADS UNLESS NOTED.
2. ALL RESISTOR VALUES ARE IN OHMS.

HIGHEST REF. NO.

R103
S105
C104
CR103
F101
J6
P6



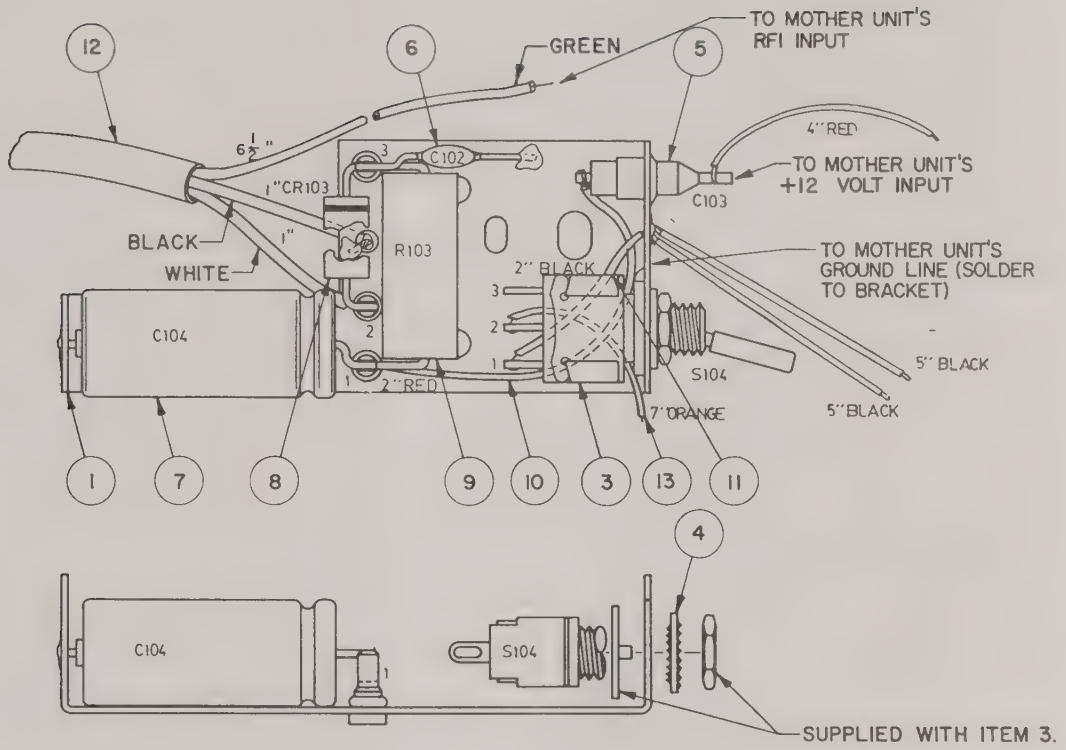
REF BOM 200-0884-20
REF DWG 300-0336-20

USED

UNUSED REF NO.
R1 THRU R100
R102
C1 THRU C101
CR1 THRU CR102
F1 THRU F100
S1 THRU S100

REVISIONS				
REV	ECO	DATE	BY	APP
0	Rel	11-85	SH	
1	7384	2-7-87	SH	

DRN SHAY	DATE 11-85	KUSTOM ELECTRONICS INC	
CHK	DATE 11-85		
ENG SH	DATE 11-85		
TOL UNLESS NOTED .XX ± .01 .XXX ± .005 ANGLES ± 1° HOLES		TITLE INTERCONNECT DIAGRAM	
		UNIT ROADRUNNER HH RADAR	
SCALE	SHT 1 OF 1	P/N 002-0325-20	C



REVISIONS				
REV	ECO	DATE	BY	APP
1	7212	2-18-85	KDM	SH
2	7285	6/24/85	SK	SH
3	7429	12-3-85	SK	SH

DRN emz	DATE 1/7 '83	KUSTOM QUALITY ELECTRONICS™
CHK	DATE 5-83	1010 W. Chestnut / Chanute, Kansas 66720 • 316 / 431-2700
ENG DWC	DATE 5-83	
TOLS. UNLESS NOTED; LINEAR XXX ± XX ± .X ± INCH: ± ANGLES ±1° HOLES #		TITLE TRIGGER BRACKET ASSEM.
		UNIT FALCON
SCALE 2:1	SHT 1 OF 1	P/N 300-0343-00 SIZE 'B'

ASSEMBLY NO: 200-0890-00
DESCRIPTION: TRIGGER BRACKET ASSY
ASSY DWG NO: 300-0343-00

REF NO	DESCRIPTION	PART NO
1	TRIGGER BRKT W/FINISH	047-1159-04
2	NOT USED	
3(S104)	SWITCH TOGGLE 1P MOM	031-0061-00
4	WASHER INT TOOTH #1/4	089-8500-08
5(C103)	CAPACITOR F/T 1500 PF W/LEADS	106-0001-00
6(C102)	CAPACITOR M/C .1 µF 50V 10%	107-0001-35
7(C104)	CAPACITOR ELECT 1000 µF 16V	095-0024-15
8(CR103)	DIODE 1N5822	007-6079-02
9(R103)	RESISTOR W/W .1 OHM 5W 10%	132-0001-02
10	WIRE 22 GA TFE RED	025-0003-02
11	WIRE 22 GA TFE BLK	025-0003-00
12	POWER CABLE	155-2044-01
13	WIRE 22 GA TFE ORN	025-0003-03

ASSEMBLY NO: 155-2044-01
DESCRIPTION: FALCON/ROADRUNNER POWER CABLE

QTY	DESCRIPTION	PART NO
1	3 CONDUCTOR COILED CORD	025-0038-00
1	STRAIN RELIEF	090-0120-00
1	CIGARETTE LIGHTER PLUG W/FUSE	090-0314-00

ASSEMBLY NO: 200-0373-11
DESCRIPTION: HORN W/WAVEGUIDE ASSY
ASSY DWG NO: 300-0097-00

QTY	DESCRIPTION	PART NO
1	LENS	088-0091-00
4	SCREW PHP 4-40 X 3/8 SEMS	089-5026-06
1	DIODE MOUNT S/ASSY	200-0544-00
1	WAVEGUIDE SUB-ASSY	200-0695-10

ASSEMBLY NO: 200-0544-00
DESCRIPTION: DIODE MOUNT S/ASSY

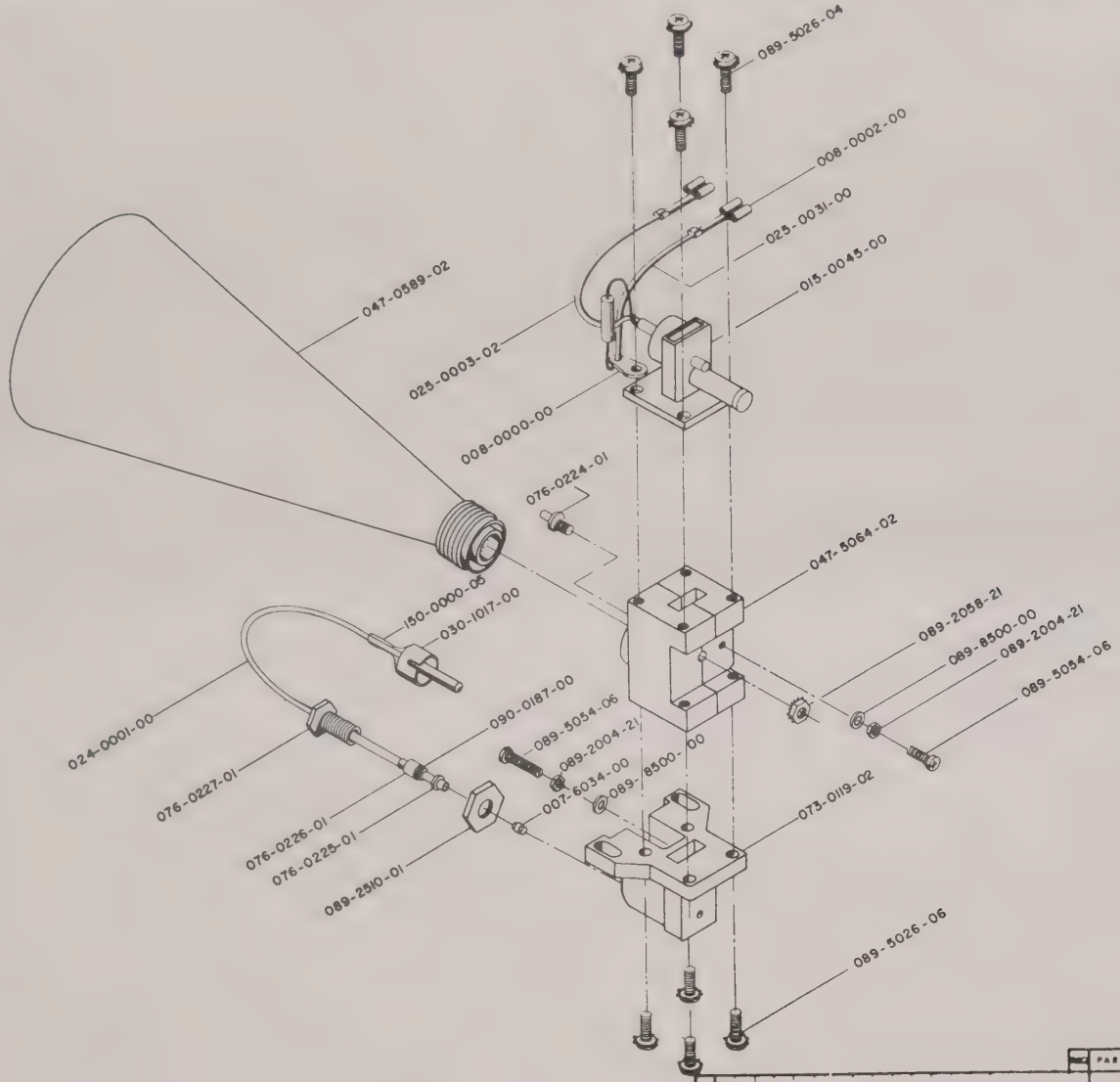
QTY	DESCRIPTION	PART NO
1	MIXER DIODE	007-6034-00
1	DIODE MOUNT	073-0119-02
1	NUT 2-56	089-2004-21
1	SCREW PHP 2-56 X 3/8	089-5054-06
1	WASHER INT TOOTH #2	089-8500-00
1	CABLE ASSY MIXER DIODE	155-2045-00

ASSEMBLY NO: 155-2045-00
DESCRIPTION: CABLE ASSY MIXER DIODE

QTY	DESCRIPTION	PART NO
	COAX RG-188 AU	024-0001-00
1	3501 MC PHONO PLUG	030-1017-00
1	CHOKE	076-0225-01
1	FERRULE	076-0226-01
1	BUSHING JAM	076-0227-01
1	HEX NUT	089-2510-01
1	FELT WASHER	090-0187-00

ASSEMBLY NO: 200-0695-10
DESCRIPTION: WAVEGUIDE S/ASSY

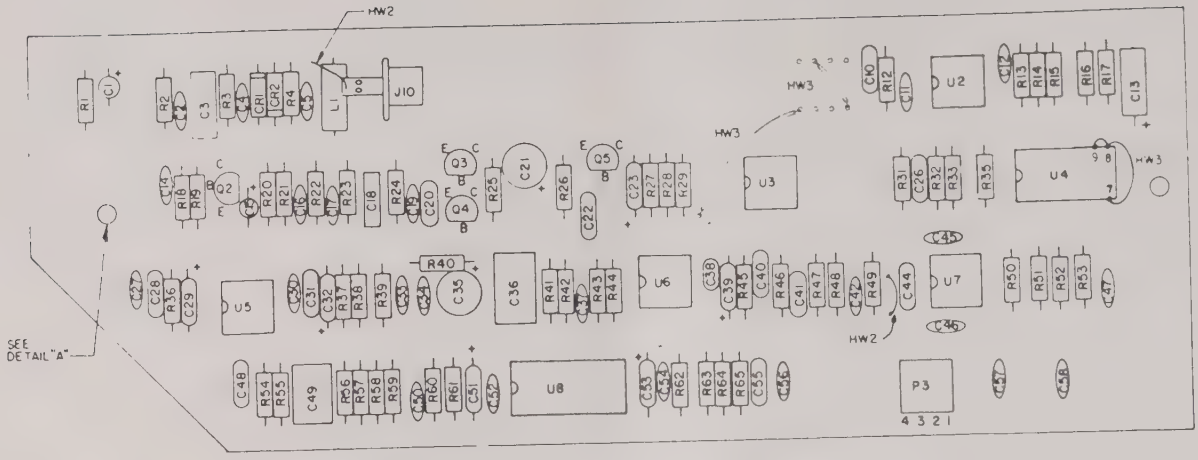
QTY	DESCRIPTION	PART NO
1	#4 GROUND LUG	008-0000-01
2	FASTON TERMINAL .300	008-0002-00
1	LV OSCILLATOR K-BAND (SOURCE)	015-0045-00
1	HORN	047-0589-02
1	WAVEGUIDE ASSY	047-5064-02
1	TUNING STUB	076-0224-01
1	NUT 2-56	089-2004-21
1	NUT HEX 4-40 KEPS	089-2058-21
4	SCREW PHP 4-40 X 1/4 SEMS	089-5026-04
1	SCREW PHP 2-56 X 3/8	089-5054-06
1	WASHER INT TOOTH #2	089-8500-00



PART NUMBER	DESCRIPTION	ITEM

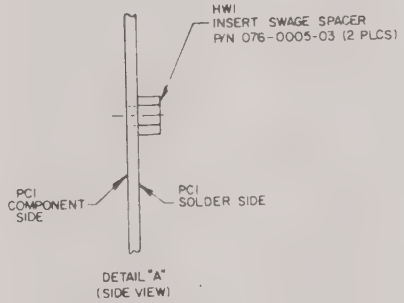
REVISIONS			
NO	ECO	DATE	BY
1	ENG 2017	1-4-77	Sharp
2		4-26-77	Sharp
3		9-77	Sharp

DRWN Pease	DATE 6-10	TOLERANCES UNLESS NOTED: XXX ± .010, MDIES ± .005, LINEAR XX ± .03, ANGLES ± 1 degree
CHK Schell	DATE 7/76	NAME ASSEMBLY DWG WAVEGUIDE
ENGR		
SCALE NTS	SHT 1 OF 1	PART NUMBER 300-0097-00



UNUSED REF NUMBERS	LAST REF NUMBERS USED
P1,P2	C58
J1-9	CR2
R5-11,30,35	J10
C6-9,24,25,45	L1
Q1	
U1	

Q5	
R65	
U8	
HW3	
P3	



NOTES

1 BEND CAPACITORS AS DESCRIBED:
- LAY C50 OVER R59
- LAY C52 AGAINST U8
- LAY C54 OVER R62
- LAY C57, C58, C47 TO THE RIGHT
- LAY C37 OVER R42

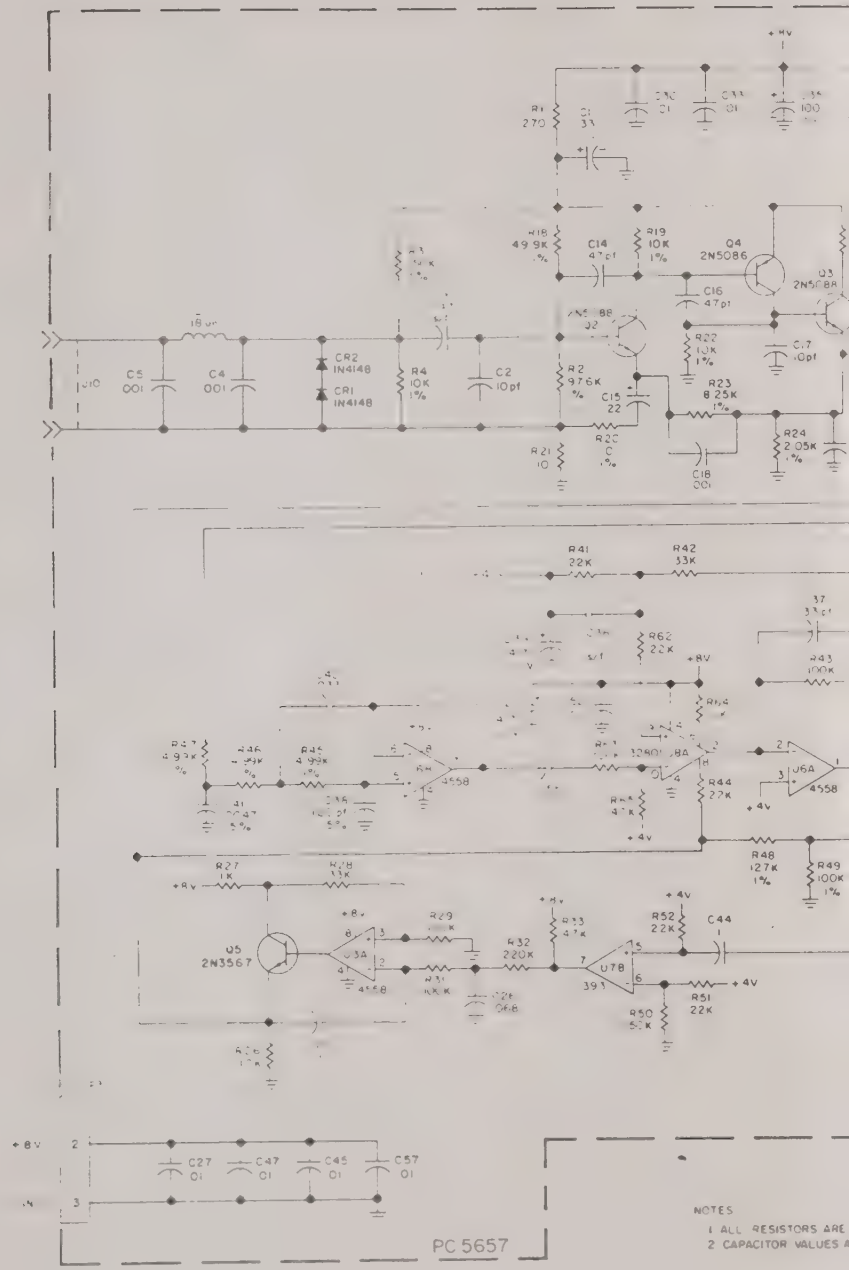
2 ALL CAPS TO BE AS FLAT AS POSSIBLE

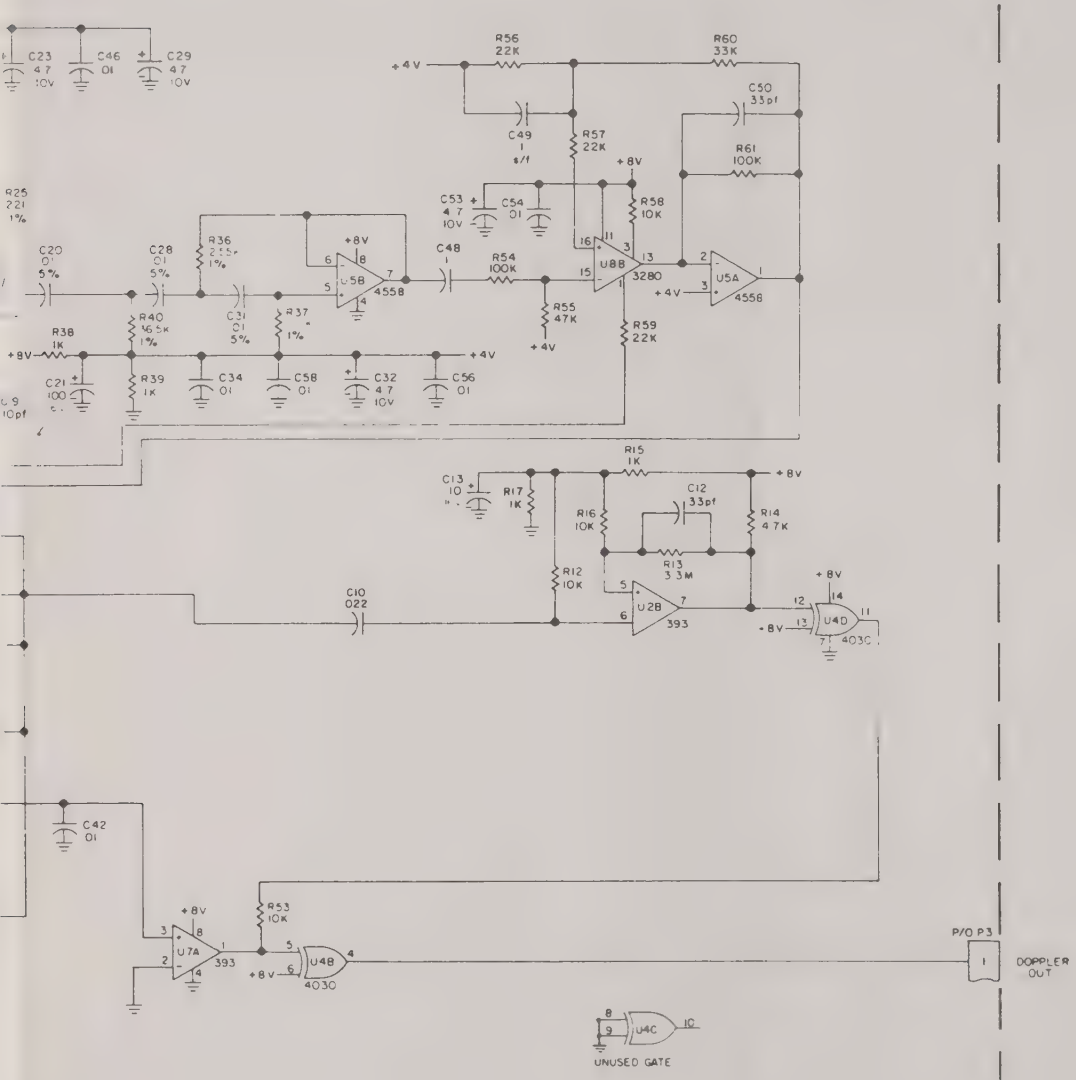
3. JUMPER U4 PINS 7, 8, and 9 TOGETHER.

EFF ARTWORK REV 1

REVISIONS				
REV	ECO	DATE	BY	APP
-	#796	2-84	BB	DWC
-	#895	7-84	WAR	DWC
-	#894	8-1-84	DRC	DWC
-	7331	7-3-85	SK	DWC
5	7345	8-1-85	SK	DWC
6	7381	8-9-85	SK	DWC
7	7484	2-18-86	SD	DWC

DRN JCV	DATE 5-83	KUSTOM ELECTRONICS
CHK RMR	DATE 5-83	
ENG DWC	DATE 1-84	
TOLS UNLESS NOTED: LINEAR ±.005, ANGLES ±1°, HOLES		TITLE ASSEMBLY- PREAMP FILTER BD, ROADRUNNER
SCALE 2:1	SHT 1 OF 1	UNIT ROADRUNNER
		P/N 300-5657-20 REV C


+8V
R1 270
C1 33
C2 10pf
C4 001
C5 001
CR2 IN4148
CR1 IN4148
R4 10K 1%
R2 9.76K 1%
C14 47pf
R18 49.9K 1%
R19 10K 1%
Q4 2N5086
C16 47pf
C17 10pf
R22 10K 1%
R23 8.25K 1%
R24 2.05K 1%
C15 22
R20 0 1%
R21 10
C18 001
R41 22K
R42 33K
R62 22K
R43 100K
R44 27K
R48 127K 1%
R49 100K 1%
R27 1K
R28 13K
R29
R31 10K
R32 220K
R33 47K
R52 22K
C44
R51 22K
R50 5K
U5 2N3567
U3A
U6A
U7B
4558
+4V
C27 01
C47 01
C45 01
C57 01
PC 5657
NOTES
1 ALL RESISTORS ARE
2 CAPACITOR VALUES A



1/4W, 5% UNLESS NOTED
RE IN MICROFARADS UNLESS NOTED

LAST REF NO USED	
Q5	U8
CR2	R65
C58	J10
L1	P3

REF NO DELETED
J1-J9
R5-11,30,35
C6-9,24,25,43
Q1
U1
P1,P2

-02

REVISIONS				
REV	ECO	DATE	BY	APP
	7384	7-24-84	DWC	DWC
	7331	7-5-84	SK	
3	7484	2-18-86	SD	

DRN	KV	DATE 5-83
CHK	RME	DATE 5-26-83
ENG	DWC	DATE 1-84

TOLS UNLESS NOTED: LINEAR .XXX ±, .XX ±, .X ±, INCH ±; ANGLES ±1°, HOLES

SCALE -0- SHT 1 OF 1

KUSTOM ELECTRONICS

TITLE SCHEMATIC
PREAMP/FILTER 80

UNIT ROADRUNNER

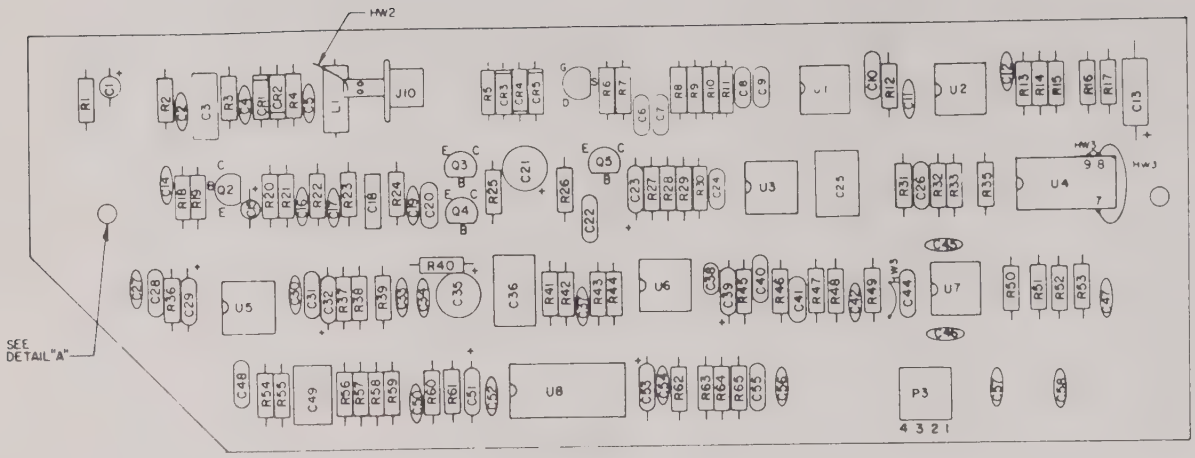
P/N 56837 20

ASSEMBLY NO: 200-5657-20
DESCRIPTION: PREAMP/FILTER BD ROADRUNNER
ASSY DWG NO: 300-5657-20

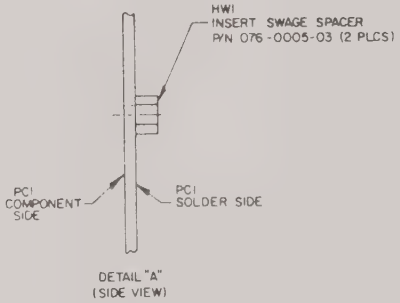
REF NO	DESCRIPTION	PART NO
C1	CAPACITOR TANT 33 µF 10V 10%	096-1007-09
C2	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C3	CAPACITOR M/P .047 µF	106-0016-05
C4,5	CAPACITOR D/C .001 µF Z5F 20%	109-1021-16
C6-9	NOT USED	
C10	CAPACITOR MLR FLM .022 µF 100V	105-0035-12
C11	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C12	CAPACITOR D/C 33 PF X5F10%	109-3300-35
C13	CAPACITOR ELECT 10 µF 16V	095-0024-02
C14	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C15	CAPACITOR TANT 22 µF 10V 10%	096-1007-02
C16	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C17	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C18	CAPACITOR MLR FLM .001 µF 100V	105-0035-00
C19	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C20	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C21	CAPACITOR ELECT 100 µF 16V	095-0023-09
C22	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C23	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C24,25	NOT USED	
C26	CAPACITOR MLR FLM .068 µF 100V	105-0035-17
C27	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C28	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C29	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C30	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C31	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C32	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C33,34	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C35	CAPACITOR ELECT 100 µF 16V	095-0023-09
C36	CAPACITOR M/P 1 µF	106-0016-03
C37	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C38	CAPACITOR D/M 120 PF 100V 5%	100-0000-28
C39	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C40	CAPACITOR MLR FLM .033 µF 100V	105-0035-13
C41	CAPACITOR MLR FLM .0047 µF 100V	105-0035-05
C42	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C43	NOT USED	
C44	CAPACITOR MLR FLM .1 µF 100V	105-0035-09
C45-47	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C48	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C49	CAPACITOR M/P 1 µF	106-0016-04
C50	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C51	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C52	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C53	CAPACITOR TANT 4.7 µF 10V10%	096-1010-01
C54	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C55	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C56-58	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
CR1,2	DIODE 1N4148	007-6016-00

REF NO	DESCRIPTION	PART NO
HW1	SPACER PC BD	076-0005-03
HW2	BUSS WIRE #22	025-1000-00
HW3	KYNAR WIRE 30 GA SIL/PL	025-1006-01
J10	PHONO JACK PC MTG	030-1019-00
L1	INDUCTOR 18 UH	019-2015-21
P3	CONN CARD 4 PIN	030-2076-04
PC1	PC BD PREAMP/FILTER	009-5657-00
Q1	NOT USED	
Q2,3	TRANSISTOR 2N5088	007-0020-00
Q4	TRANSISTOR 2N5086	007-0021-00
Q5	TRANSISTOR 2N3567	007-0005-00
R1	RESISTOR D/C 270 OHM 1/4W 5%	130-0271-23
R2	RESISTOR MFLM 97.6K 1/8W 1%	125-9762-01
R3	RESISTOR MFLM 150K 1/8W1%	125-1503-01
R4	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R5-11	NOT USED	
R12	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R13	RESISTOR C/F 3.3 MEG 1/4W 5%	130-0335-23
R14	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R15	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R16	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R17	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R18	RESISTOR MFLM 49.9K 1/8W 1%	125-4992-01
R19	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R20	RESISTOR MFLM 10 OHM 1/8W 1%	125-0100-01
R21	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R22	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R23	RESISTOR MFLM 8.25K 1/8W 1%	125-8251-01
R24	RESISTOR MFLM 2.05K 1/8W 1%	125-2051-01
R25	RESISTOR MFLM 221 OHM 1/8W 1%	125-2210-01
R26	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R27	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R28	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R29	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R30	NOT USED	
R31	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R32	RESISTOR C/F 220K 1/4W 5%	130-0224-23
R33	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R34	NOT USED	
R35	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R36	RESISTOR MFLM 2.55K 1/8W 1%	125-2551-01
R37	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R38,39	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R40	RESISTOR MFLM 36.5K 1/8W 1%	125-3652-01
R41	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R42	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R43	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R44	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R45-47	RESISTOR MFLM 4.99K 1/8W 1%	125-4991-01
R48	RESISTOR MFLM 127K 1/8W 1%	125-1273-01
R49	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R50	RESISTOR C/F 150K 1/4W 5%	130-0154-23
R51,52	RESISTOR C/F 22K 1/4W 5%	130-0223-23

REF NO	DESCRIPTION	PART NO
R53	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R54	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R55	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R56,57	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R58	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R59	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R60	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R61	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R62	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R63	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R64	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R65	RESISTOR C/F 47K 1/4W 5%	130-0473-23
U1	NOT USED	
U2	IC 393 VOLT COMP	007-7225-00
U3	IC 4558 DUAL OP AMP	007-7201-00
U4	IC 4070B QUAD 2-INPUT XOR	007-7257-00
U5,6	IC 4558 DUAL OP AMP	007-7201-00
U7	IC 393 VOLT COMP	007-7225-00
U8	IC 3280 XCNDCT AMP	007-7286-00



UNUSED REF NUMBERS	LAST REF NUMBERS USED
P1, P2	C58
J1-9	CR6
C43	J10
	L1
	Q5
	R65
	U8
	HW3
	P3



NOTES

1 BEND CAPACITORS AS DESCRIBED: LAY C50 OVER R59
LAY C52 AGAINST U8
LAY C54 OVER R62
LAY C57, C58, C47 TO THE RIGHT
LAY C37 OVER R42

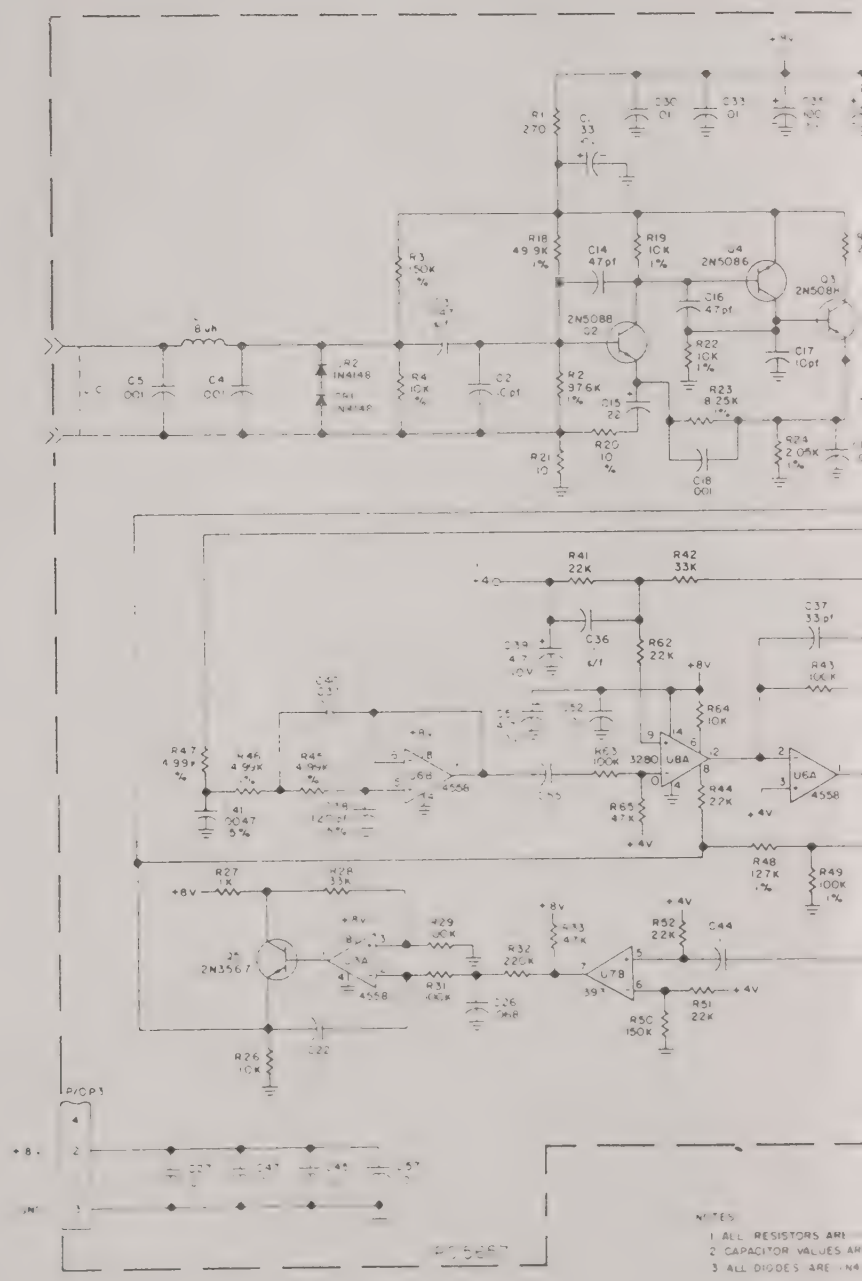
2 ALL CAPS TO BE AS FLAT AS POSSIBLE

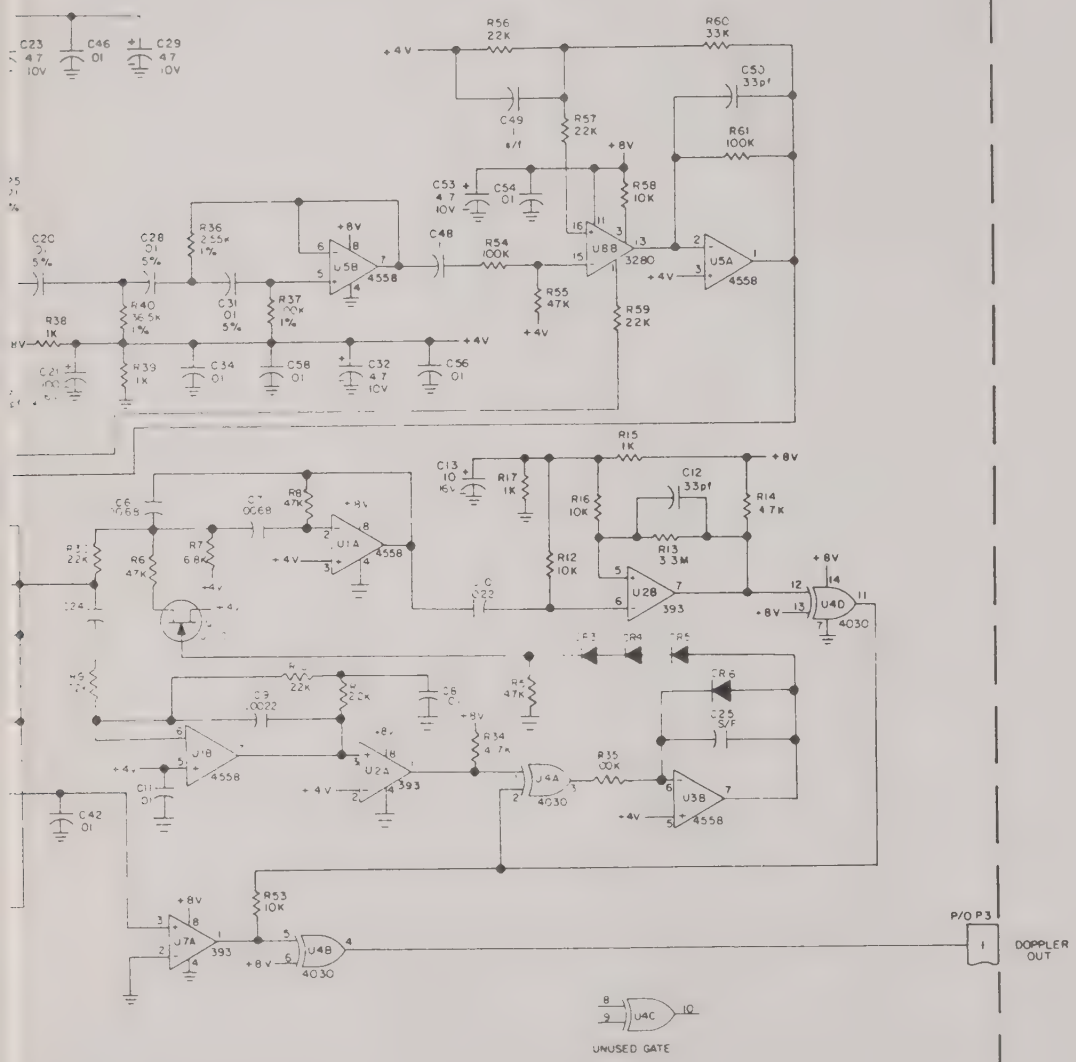
3 JUMPER U4 PINS 7, 8 AND 9 TOGETHER

EFF ARTWORK REV 1

REVISIONS				
REV	ECO	DATE	BY	APP
0	RE_	1-7-86	MJ	
1	7484	2-18-86	SD	

DRN MJ	DATE 1-23-86	KUSTOM ELECTRONICS
CHK	DATE	
ENG	DATE	
TOLS UNLESS NOTED. LINEAR ANGLES ±1° HOLES		TITLE ASSEMBLY-W/TBPF PREAMP FILTER BD, FALCON
SCALE	SHT 1 OF 1	UNIT ROADRUNNER
		P/N 300-5857-21 REV C


R1 270
C33 .01
R18 49.9K 1%
C14 47pf
R19 10K 1%
Q4 2N5086
Q3 2N5089
C16 47pf
R3 150K
2N5088 Q2
R22 10K 1%
C17 10pf
8uh
C5 .001
C4 .001
D2 IN4148
R4 10K
C2 .01
R2 97.6K 1%
C15 22
R23 8.25K 1%
R20 10
R21 10
C18 .001
R24 2.05K 1%
R41 22K
R42 33K
+4
C37 33pf
C36 .1
R62 22K
+8V
R43 100K
R64 10K
R47 4.99K 1%
R44 4.99K 1%
4556
R63 100K
3280 U8A
U6A 4558
R44 22K
R65 47K
+4V
R48 127K 1%
R49 100K 1%
R27 1K
R28 33K
2N3567
R29 100K
R32 220K
R33 47K
U7B
R52 22K
C44
R31 100K
R51 22K
R50 150K
R26 10K
C22
P/O P3
+8
NOTES
1 ALL RESISTORS ARE
2 CAPACITOR VALUES ARE
3 ALL DIODES ARE IN4



4W, 5% UNLESS NOTED
E IN MICROFARADS UNLESS NOTED
48 UNLESS OTHERWISE INDICATED

LAST REF NO USED	
J5	U8
CR6	R65
C58	J10
C1	P3

REF NO DELETED
J1-J9
C43
P1, P2

REVISIONS				
REV	ECO	DATE	BY	APP
0	REL	1-86	MB	
1	7484	2-18-86	SD	

-0 1
-00 1
EFF ARTWORK REV

DRN MB DATE 1-86
CHK DATE
ENG DATE 1-3-86
TOLS UNLESS NOTED
LINEAR .XX .XXX ANGLES ±1° HOLES
SCALE NONE SHT 1 OF 1

KUSTOM ELECTRONICS

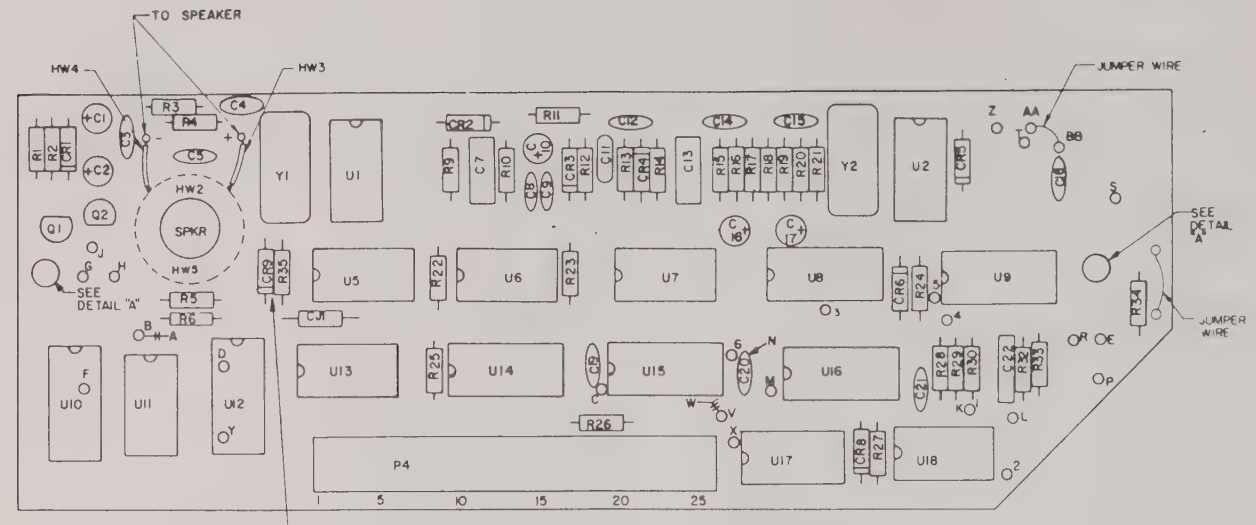
TITLE SCHEMATIC
PREAMP/FILTER BD W/TBPF
UNIT ROADRANGER
P/N 002-5657-21 REV 0

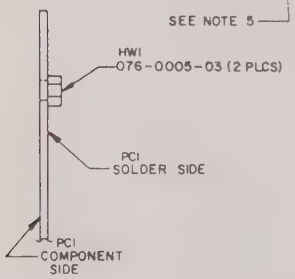
ASSEMBLY NO: 200-5657-21
DESCRIPTION: PREAMP/FILTER BD ROADRUNNER
ASSY DWG NO: 300-5657-21

REF NO	DESCRIPTION	PART NO
C1	CAPACITOR TANT 33 µF 10V 10%	096-1007-09
C2	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C3	CAPACITOR M/P .047 µF	106-0016-05
C4,5	CAPACITOR D/C .001 µF Z5F 20%	109-1021-16
C6,7	CAPACITOR MLR FLM .0068 µF 100V	105-0035-07
C8	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C9	CAPACITOR MLR FLM .0022 µF 100V	105-0035-02
C10	CAPACITOR MLR FLM .022 µF 100V	105-0035-12
C11	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C12	CAPACITOR D/C 33 PF X5F10%	109-3300-35
C13	CAPACITOR ELECT 10 µF 16V	095-0024-02
C14	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C15	CAPACITOR TANT 22 µF 10V 10%	096-1007-02
C16	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C17	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C18	CAPACITOR MLR FLM .001 µF 100V	105-0035-00
C19	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C20	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C21	CAPACITOR ELECT 100 µF 16V	095-0023-09
C22	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C23	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C24	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C25	CAPACITOR M/P 1 µF	106-0016-03
C26	CAPACITOR MLR FLM .068 µF 100V	105-0035-17
C27	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C28	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C29	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C30	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C31	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C32	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C33,34	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C35	CAPACITOR ELECT 100 µF 16V	095-0023-09
C36	CAPACITOR M/P 1 µF	106-0016-03
C37	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C38	CAPACITOR D/M 120 PF 100V 5%	100-0000-28
C39	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C40	CAPACITOR MLR FLM .033 µF 100V	105-0035-13
C41	CAPACITOR MLR FLM .0047 µF 100V	105-0035-05
C42	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C43	NOT USED	
C44	CAPACITOR MLR FLM .1 µF 100V	105-0035-09
C45-47	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C48	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C49	CAPACITOR M/P 1 µF	106-0016-04
C50	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C51	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C52	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C53	CAPACITOR TANT 4.7 µF 10V10%	096-1010-01

REF NO	DESCRIPTION	PART NO
C54	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C55	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C56-58	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
CR1-6	DIODE 1N4148	007-6016-00
HW1	SPACER PC BD	076-0005-03
HW2	BUSS WIRE #22	025-1000-00
HW3	KYNAR WIRE 30 GA SIL/PL	025-1006-01
J10	PHONO JACK PC MTG	030-1019-00
L1	INDUCTOR 18 UH	019-2015-21
P3	CONN CARD 4 PIN	030-2076-04
PC1	PC BD PREAMP/FILTER	009-5657-00
Q1	TRANSISTOR JFET J110	007-0090-00
Q2,3	TRANSISTOR 2N5088	007-0020-00
Q4	TRANSISTOR 2N5086	007-0021-00
Q5	TRANSISTOR 2N3567	007-0005-00
R1	RESISTOR C/F 270 OHM 1/4W 5%	130-0271-23
R2	RESISTOR MFLM 97.6K 1/8W 1%	125-9762-01
R3	RESISTOR MFLM 150K 1/8W1%	125-1503-01
R4	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R5	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R6	RESISTOR C/F 47 OHM 1/4W 5%	130-0470-23
R7	RESISTOR C/F 6.8K 1/4W 5%	130-0682-23
R8	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R9-11	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R12	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R13	RESISTOR C/F 3.3 MEG 1/4W 5%	130-0335-23
R14	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R15	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R16	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R17	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R18	RESISTOR MFLM 49.9K 1/8W 1%	125-4992-01
R19	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R20	RESISTOR MFLM 10 OHM 1/8W 1%	125-0100-01
R21	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R22	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R23	RESISTOR MFLM 8.25K 1/8W 1%	125-8251-01
R24	RESISTOR MFLM 2.05K 1/8W 1%	125-2051-01
R25	RESISTOR MFLM 221 OHM 1/8W 1%	125-2210-01
R26	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R27	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R28	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R29	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R30	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R31	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R32	RESISTOR C/F 220K 1/4W 5%	130-0224-23
R33,34	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R35	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R36	RESISTOR MFLM 2.55K 1/8W 1%	125-2551-01
R37	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R38,39	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R40	RESISTOR MFLM 36.5K 1/8W 1%	125-3652-01
R41	RESISTOR C/F 22K 1/4W 5%	130-0223-23

REF NO	DESCRIPTION	PART NO
R42	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R43	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R44	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R45-47	RESISTOR MFLM 4.99K 1/8W 1%	125-4991-01
R48	RESISTOR MFLM 127K 1/8W 1%	125-1273-01
R49	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R50	RESISTOR C/F 150K 1/4W 5%	130-0154-23
R51,52	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R53	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R54	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R55	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R56,57	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R58	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R59	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R60	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R61	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R62	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R63	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R64	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R65	RESISTOR C/F 47K 1/4W 5%	130-0473-23
U1	IC 4558 DUAL OP AMP	007-7201-00
U2	IC 393 VOLT COMP	007-7225-00
U3	IC 4558 DUAL OP AMP	007-7201-00
U4	IC 4070B QUAD 2-INPUT XOR	007-7257-00
U5,6	IC 4558 DUAL OP AMP	007-7201-00
U7	IC 393 VOLT COMP	007-7225-00
U8	IC 3280 XCNDCT AMP	007-7286-00





DETAIL "A"

Q1,Q2 TOP VIEW

UNUSED REF NUMBERS

P1 — P3
U3,4
CR7
C6
R6,7,8,31

HIGHEST REF NUMBERS USED

U18	R35
Y2	Q2
CJ1	P4
C22	CR9 HW5

UNIT	CUT	ADD JUMPER	002-5656-XX
STND	—	—	-20
1 MPH	B-D K-L M-N G-H	D-N L-N M-Y H-J	-21
KPH	A-B P-R	B-C E-P	-22
.1 KPH	A-B B-D G-H M-N P-R K-L	B-C H-J D-N M-Y E-P L-N	-23
KNOTS			-24
.1 KNOTS	B-D K-L M-N G-H	D-N L-N M-Y H-J	-25

NOTES

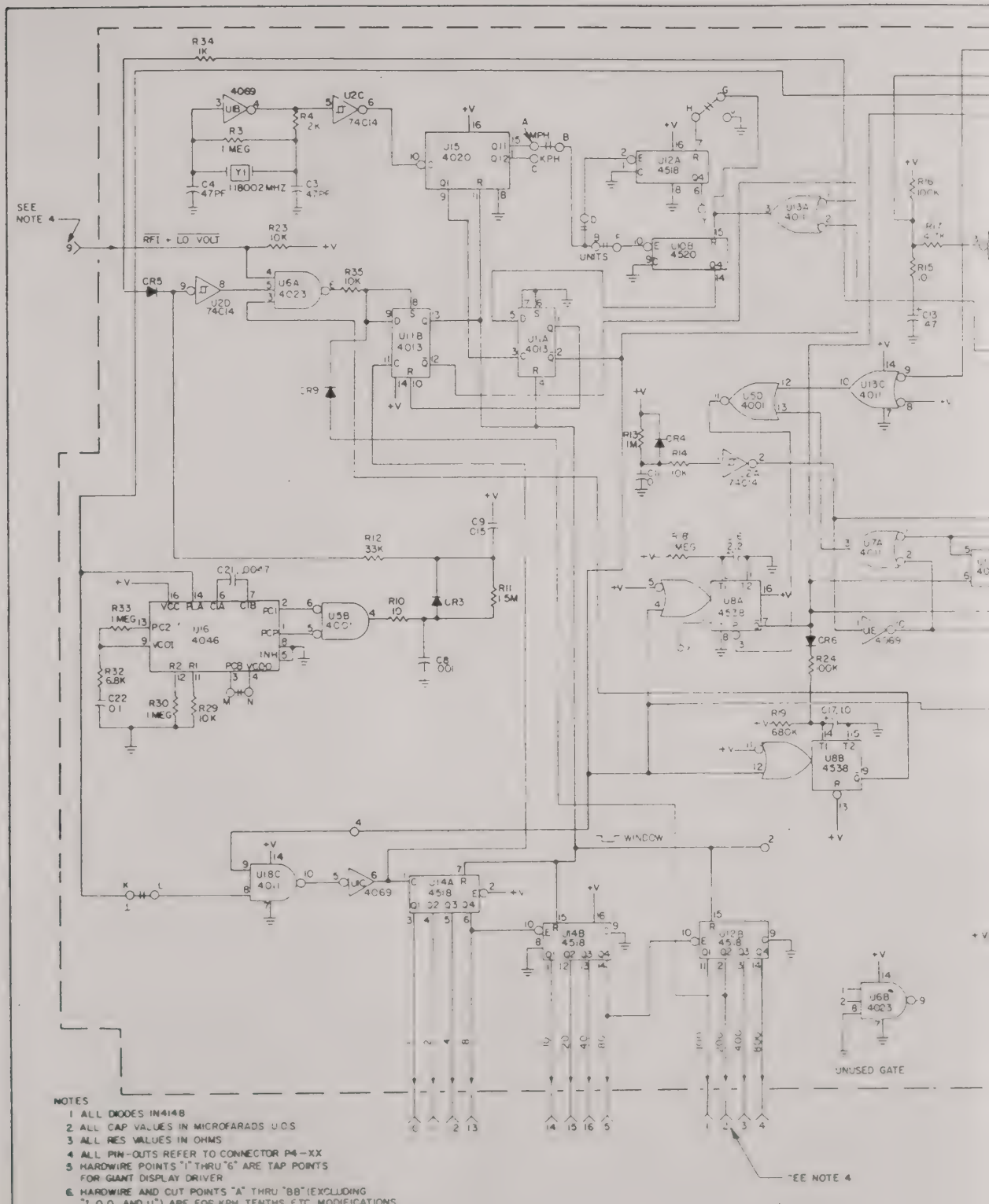
1. LABELS "1" THRU "6" ARE FOR GIANT DISPLAY DRIVER BOARD TAP POINTS
2. LABELS "A" THRU "BB" (EXCLUDING "I, O, Q, U") ARE FOR KPH, .1 KPH, .1 MPH, ETC. OPTIONS.
3. LABELS ON COMPONENT SIDE 2,3,4,5,6,A,B,K,L,V,W,X
4. LABELS ON SOLDER SIDE: I,C,D,E,F,G,H,J,M,N,P,R,S,T,Y,Z,AA,BB
5. FOR ANY TENTHS UNIT REMOVE CR9.

* FOR KPH AND .1 KPH:
Y1 = 1.466465 MHz (KPN 044-0000-16)
Y2 = 1.472216 MHz (KPN 044-0000-18)
FOR KNOTS AND .1 KNOTS
Y1 = 1.357947 MHz (KPN 044-0000-19)
Y2 = 1.379195 MHz (KPN 044-0000-20)

003-5656-0002 | 3
EFF ARTWORK | REV

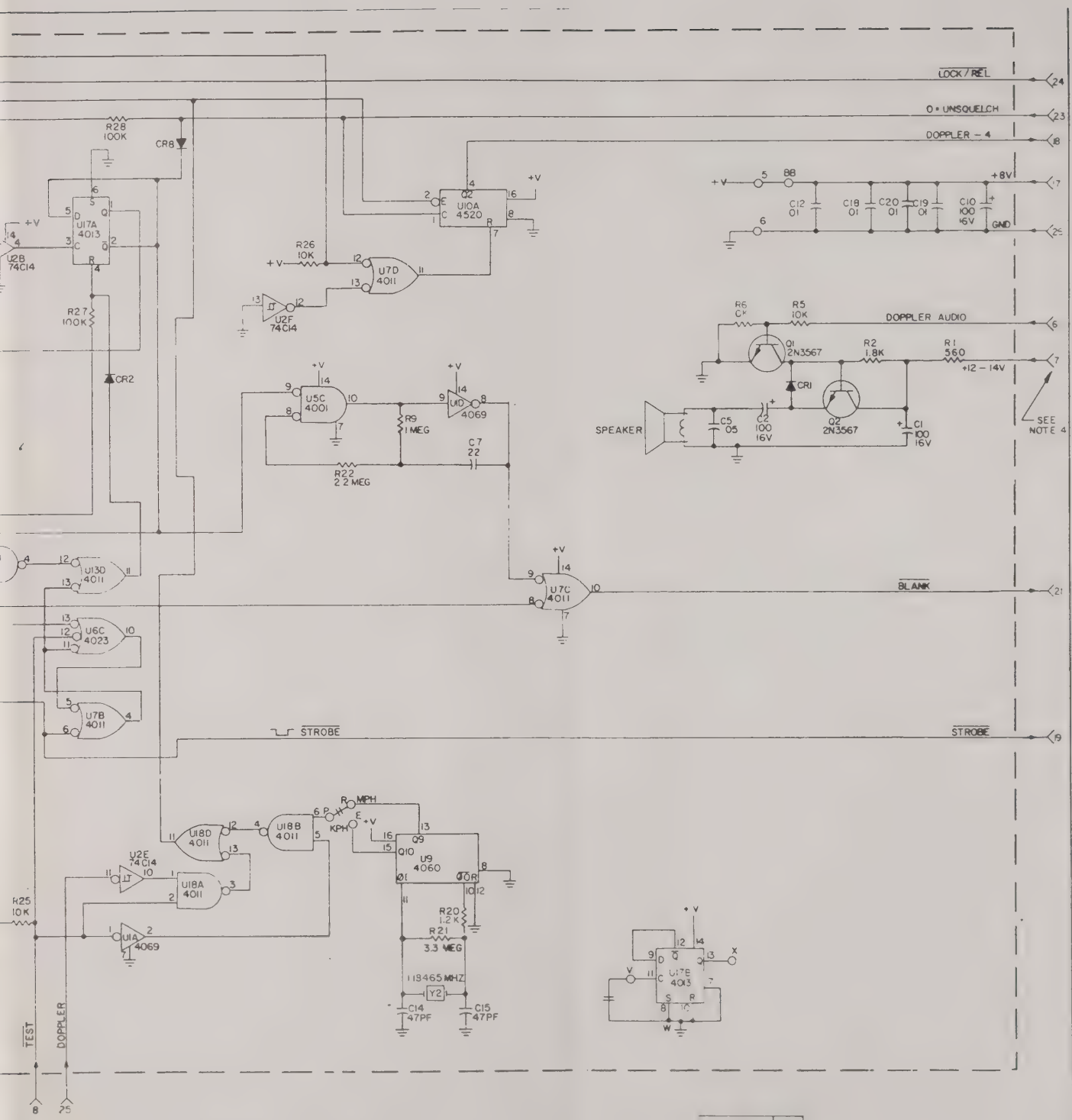
REVISIONS				
REV	ECO	DATE	BY	APP
1	7360	7-22-86	JND	
2	6895	7-84	SMAY	
3	6983	5-7-84	DRC	
4	7144	10-30-84	MAN	
5	7227	2-85	MDM	SH
6	7275	6-5-86	SK	
7	7307	10-9-85	MA	
8	1429	11-4-	SK	
9	7484	2-18-86	SD	
10	7547	4-24-86	SD	

DRN JCV DATE 5-1-83
CHK DATE 5-5
ENG DATE 7-6
TOLS UNLESS NOTED. LINEAR XXX ± XX ± X ± ANGLES ±1° HOLES
KUSTOM SIGNATURE ELECTRONICS
TITLE ASSEMBLY — LOGIC BOARD, ROADRUNNER
UNIT ROADRUNNER
SCALE 2:1 SHT 1 OF 1
P/N 300-5656-20 SIZE C



NOTES

1. ALL DIODES IN4148
2. ALL CAP VALUES IN MICROFARADS U.O.S
3. ALL RES VALUES IN OHMS
4. ALL PIN-OUTS REFER TO CONNECTOR P4-XX
5. HARDWIRE POINTS "1" THRU "6" ARE TAP POINTS FOR GIANT DISPLAY DRIVER
6. HARDWIRE AND CUT POINTS "A" THRU "BB" (EXCLUDING "I, O, Q, AND U") ARE FOR KPH, TENTHS, ETC MODIFICATIONS



HIGHEST REF. NUMBERS USED	
C22	Q2
CJ1	R35
C99	U18
P4	Y2

UNUSED REF. NUMBERS
P1-P3
U3,4
R6-8,31
C6
CR7

-02	
-01	
-00	

EFF ARTWORK

REVISIONS				
REV	ECO	DATE	BY	APP
1	6985	8-84	DEC	
2	7144			
3	7227		DM	SH
4				
5				
6	7484	2-18-86	SD	

DRN DATE
CHK DATE
ENG DATE
TOLS UNLESS NOTED
LINEAR ANGLES ±1° HOLES
SCALE SHT 1 OF 1

KUSTOM ELECTRONICS

TITLE LOGIC BOARD MPH

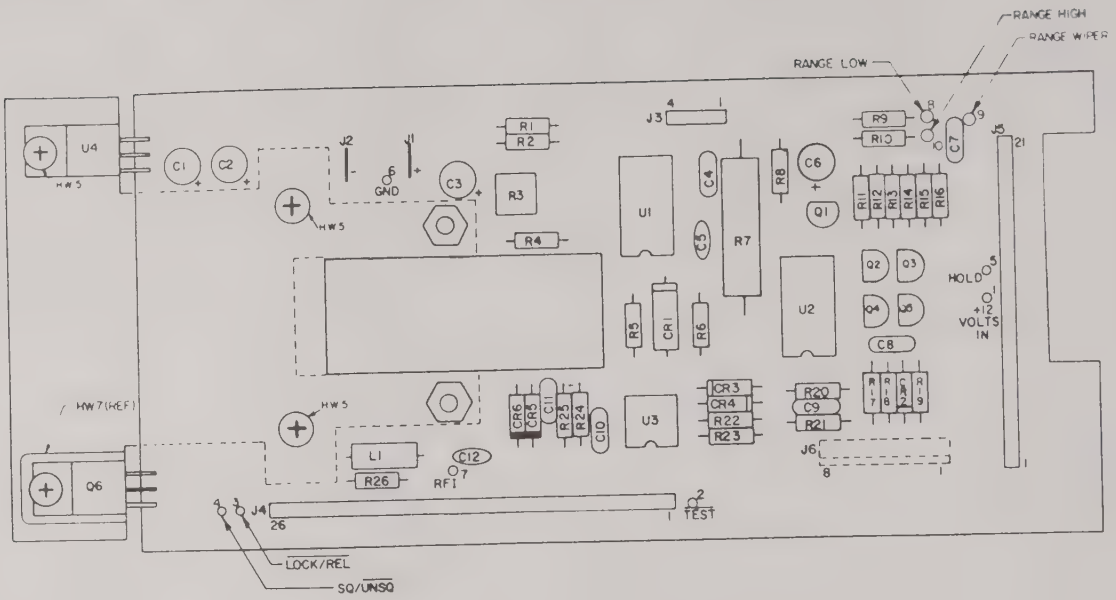
UNIT

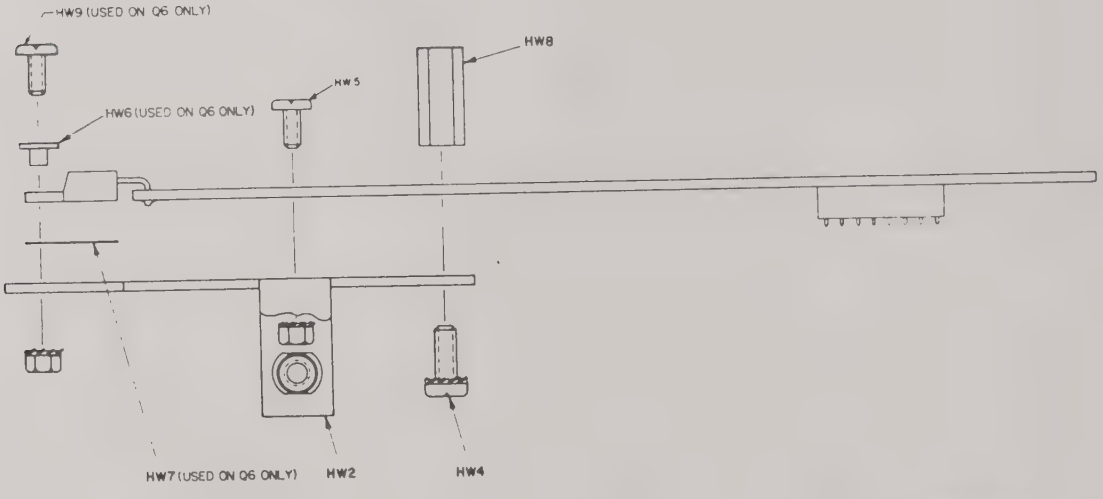
P/N 002-5656-2[illegible] REV 0

ASSEMBLY NO: 200-5656-20
DESCRIPTION: LOGIC BD ROADRUNNER
ASSY DWG NO: 300-5656-20

REF NO	DESCRIPTION	PART NO
C1,2	CAPACITOR ELECT 100 µF 16V	095-0023-09
C3,4	CAPACITOR D/M 47 PF 300V 5%	100-0003-14
C5	CAPACITOR D/C .05 µF Z5T	109-5034-67
C6	NOT USED	
C7	CAPACITOR M/P .22 µF	106-0016-01
C8	CAPACITOR MLR FLM .001 µF 100V	105-0035-00
C9	CAPACITOR MLR FLM .015 µF 100V	105-0035-10
C10	CAPACITOR ELECT 100 µF 16V	095-0023-09
C11	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C12	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C13	CAPACITOR M/P .47 µF	106-0016-02
C14,15	CAPACITOR D/M 47 PF 300V 5%	100-0003-14
C16	CAPACITOR ELECT 2.2 µF 35V	096-0023-08
C17	CAPACITOR ELECT 1 µF 35V	095-0023-00
C18-20	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C21	CAPACITOR MLR FLM .0047 µF 100V	105-0035-05
C22	CAPACITOR M/P .1 µF	106-0016-00
CJ1	CIRCUIT JUMPER	090-0270-00
CR1-6	DIODE 1N4148	007-6016-00
CR7	NOT USED	
CR8,9	DIODE 1N4148	007-6016-00
HW1	SPACER PC BD	076-0005-03
HW2	FISH PAPER WASHER	012-0006-30
HW3	WIRE 26 GA TFE CW RED	025-0006-22
HW4	WIRE 26 GA TFE CW BLK	025-0006-00
P1-3	NOT USED	
P4	CONN CARD 26 PIN	030-2076-26
PC1	LOGIC PC BD	009-5656-00
Q1,2	TRANSISTOR 2N3567	007-0005-00
R1	RESISTOR C/F 560 OHM 1/4W 5%	130-0561-23
R2	RESISTOR C/F 1.8K 1/4W 5%	130-0182-23
R3	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R4	RESISTOR C/F 1.2K 1/4W 5%	130-0122-23
R5,6	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R7,8	NOT USED	
R9	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R10	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R11	RESISTOR C/F 1.5 MEG 1/4W 5%	130-0155-23
R12	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R13	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R14	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R15	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R16	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R17	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R18	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R19	RESISTOR C/F 680K 1/4W 5%	130-0684-23
R20	RESISTOR C/F 1.2K 1/4W 5%	130-0122-23
R21	RESISTOR C/F 3.3 MEG 1/4W 5%	130-0335-23
R22	RESISTOR C/F 2.2 MEG 1/4W 5%	130-0225-23

REF NO	DESCRIPTION	PART NO
R23	RESISTOR C/F 10K OHM 1/4W 5%	130-0103-23
R24	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R25,26	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R27,28	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R29	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R30	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R31	NOT USED	
R32	RESISTOR C/F 6.8K 1/4W 5%	130-0682-23
R33	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R34	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R35	RESISTOR C/F 10K 1/4W 5%	130-0103-23
SPKR	SPEAKER 1 1/2 INCH	038-0114-00
U1	IC 4069 HEX INV UNBUF	007-7238-00
U2	IC 74C14 HEX SCHMITT TRIGGER	007-7207-00
U3,4	NOT USED	
U5	IC 4001 QUAD 2-INPUT NOR	007-7187-00
U6	IC 4023 TRIPLE 3-INPUT NAND	007-7170-00
U7	IC 4011 QUAD 2-INPUT NAND	007-7163-00
U8	IC 4538 DUAL MONO	007-7255-00
U9	IC 4060 BINARY COUNTER/DIVIDER	007-7253-00
U10	IC 4520 DUAL BINARY UP CNTR	007-7206-00
U11	IC 4013 DUAL D FLIP-FLOP	007-7165-00
U12	IC 4518 DUAL BCD UP CNTR	007-7205-00
U13	IC 4011 QUAD 2-INPUT NAND	007-7163-00
U14	IC 4518 DUAL BCD UP CNTR	007-7205-00
U15	IC 4020 BINARY COUNTER	007-7168-00
U16	IC 4046 PLL	007-7190-00
U17	IC 4013 DUAL D-FLIP-FLOP	007-7165-00
U18	IC 4011 QUAD 2-INPUT NAND	007-7163-00
Y1	CRYSTAL 1.180024 MHZ	044-0000-15
Y2	CRYSTAL 1.184651 MHZ	044-0000-17





2N3567

EBC
(TOP VIEW)

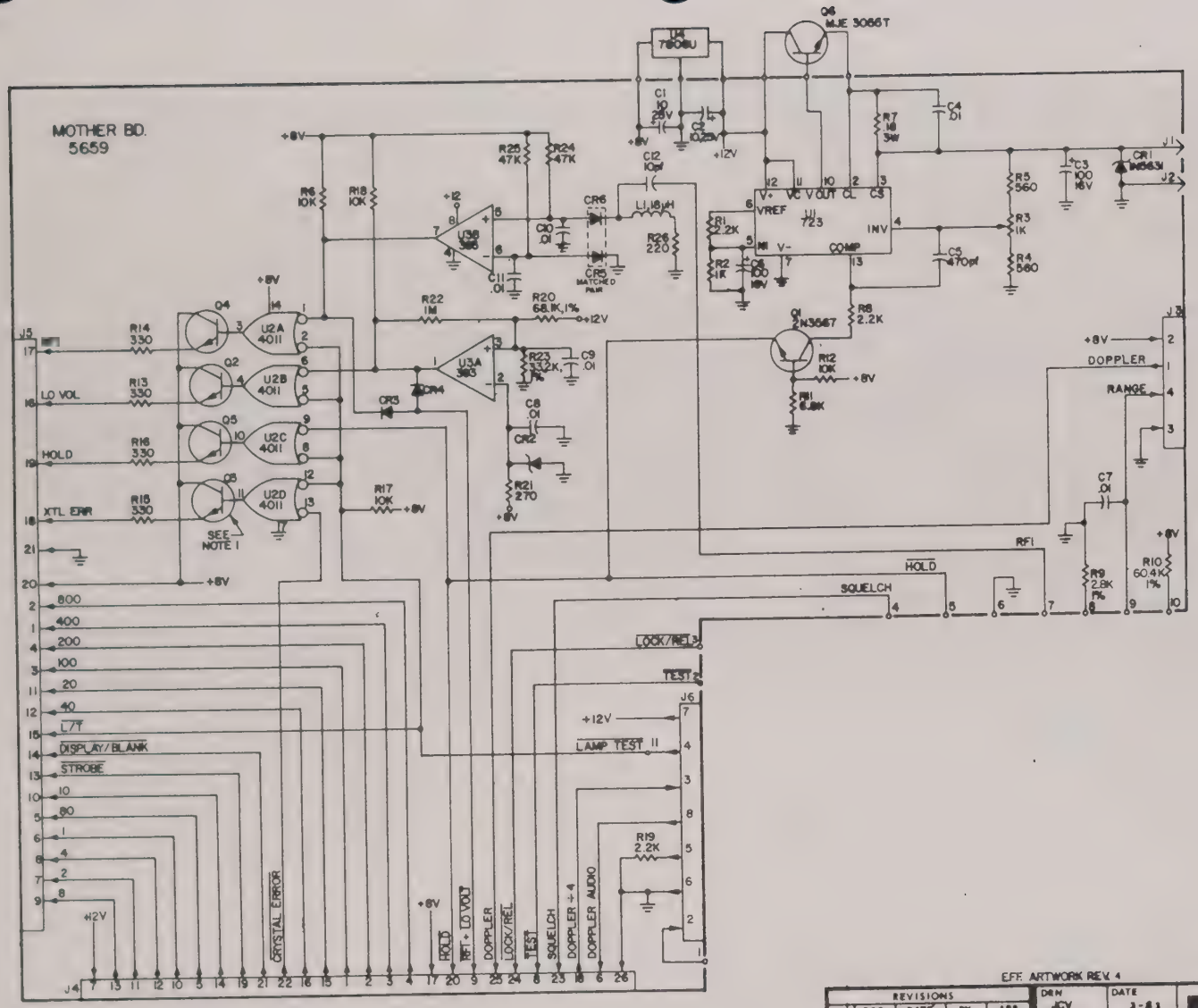
HIGHEST REF NUMBERS USED

C12	Q6
CR6	R26
L1	U4
J6	

EFFECTIVE ARTWORK REV 4

REVISIONS				
REV	ECO	DATE	BY	APP
1	6356	2-83	TSE	
2	6410	7-83	JCV	
3	6477	8-83	TSE	
4	6870	9-26-85	PSW	
5	7396	2-18-86	MA	
6	7464	2/13/86	BD	
7	7491	3/24/86	BD	
8	7568	5/21/86	SB	
9	7576	6-26-86	SHD	

DRN JCV	DATE 1-83	KUSTOM QUALITY ELECTRONICS™	
CHK RW	DATE 3-10-83		
ENG Dux	DATE 5-83		
TOLS. UNLESS NOTED, LINEAR: .XX ± .X ± .XXX ± ANGLES ±1° HOLES		TITLE ASSEMBLY - MOTHER BD., FALCON	
		UNIT FALCON, K-BAND RADAR	
SCALE 2:1	SHT 1 OF 1	P/N 300-8600-00	REV C



NOTES:
1. VALUES FOR Q2 THRU Q5 ARE ALL 2N3667.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED.

EFF. ARTWORK REV. 4

REVISIONS				
REV	ECO	DATE	BY	APP
1	[illegible]	7-83	[illegible]	[illegible]
2	[illegible]	7-83	JCV	[illegible]
3	7290	8-7-85	SK	[illegible]
4	7398	2-18-86	KS	[illegible]
5	7484	2/13/86	SD	[illegible]
6	[illegible]	3-24-86	SD	[illegible]
7	7554	9-86	SHD	[illegible]

DRN	JCV	DATE 3-83
CHK	[illegible]	DATE 3-10-83
ENG	RWS	DATE 5-83

UNLESS NOTED: DIMENSIONS ARE IN INCHES. TOLERANCES ON [illegible]

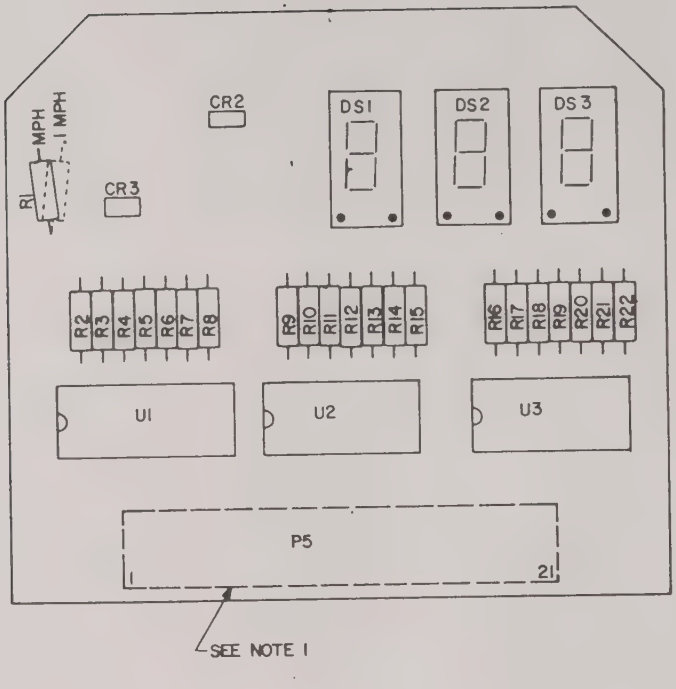
KUSTOM QUALITY ELECTRONICS™

TITLE: SCHEMATIC - MOTHER BOARD, [illegible]

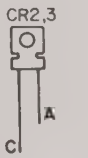
ASSEMBLY NO: 200-5659-00
DESCRIPTION: MOTHER BD FALCON, ROADRUNNER
ASSY DWG NO: 300-5659-00

REF NO	DESCRIPTION	PART NO
C1,2	CAPACITOR ELECT 10 µF 25V	095-0023-01
C3	CAPACITOR ELECT 100 µF 16V	095-0023-09
C4	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C5	CAPACITOR D/C 470 PF X5F 10%	109-4710-35
C6	CAPACITOR ELECT 100 µF 16V	095-0023-09
C7-11	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C12	CAPACITOR D/C 10 PF X5F 10%	109-1000-35
CR1	DIODE 1.5KE8.2A VOLT SUPR	007-5067-06
CR2	DIODE 1N5226B	007-5085-05
CR3,4	DIODE 1N4148	007-6016-00
CR5,6	DIODE 1N4148 PAIR ASSY	007-6096-00
HW1	NOT USED	
HW2	BRKT TRANS W/HW	047-1890-00
HW3	NUT HEX 4-40 KEPS	089-2058-21
HW4	SCREW PHP 6-32 X 3/8 SEMS	089-5028-06
HW5	SCREW PHP 4-40 X 1/4	089-5058-04
HW6	WASHER NYLON	090-0004-00
HW7	MICA INSULATOR	090-0170-00
HW8	SPACER .450 X .250 6-32	076-0001-23
HW9	SCREW PHP 4-40 X 5/16	089-5058-05
J1,2	FASTON TERM TAB .250	008-0028-02
J3	CONTACT STRIP 4 PIN	030-2078-04
J4	CONTACT STRIP 26 PIN	030-2078-26
J5	CONTACT STRIP 21 PIN	030-2078-21
J6	POST HEADER 8 PIN	030-2144-06
L1	INDUCTOR 18 µH	019-2015-21
PC1	PCB MOTHER BD	009-5659-00
Q1-5	TRANSISTOR 2N3567	007-0005-00
Q6	TRANSISTOR MJE-3055T	007-0083-00
R1	RESISTOR C/F 2.2K 1/4W 5%	130-0222-23
R2	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R3	POT 1K 1T 10% 3386Y	133-0103-02
R4,5	RESISTOR C/F 560 OHM 1/4W 5%	130-0561-23
R6	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R7	RESISTOR .18 OHM 3W 10%	132-0001-09
R8	RESISTOR C/F 2.2K 1/4W 5%	130-0222-23
R9	RESISTOR MFLM 2.8K 1/8W 1%	125-2801-01
R10	RESISTOR MFLM 60.4K 1/8W1%	125-6042-01
R11	RESISTOR C/F 6.8K 1/4W 5%	130-0682-23
R12	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R13-16	RESISTOR C/F 330 OHM 1/4W 5%	130-0331-23
R17,18	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R19	RESISTOR C/F 2.2K 1/4W 5%	130-0222-23
R20	RESISTOR MFLM 68.1K 1/8W 1%	125-6812-01
R21	RESISTOR C/F 270 OHM 1/4W 5%	130-0271-23
R22	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23

REF NO	DESCRIPTION	PART NO
R23	RESISTOR MFLM 33.2K 1/8W 1%	125-3572-01
R24,25	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R26	RESISTOR C/F 220 OHM 1/4W 5%	130-0221-23
U1	IC 723 VOLT REG DIP ADJ	007-7013-00
U2	IC 4011 QUAD 2-INPUT NAND	007-7163-00
U3	IC 393 VOLT COMP	007-7225-00
U4	IC 340T-8 VOLT REG	007-7150-24



UNUSED REF. NUMBERS	HIGHEST REF. NUMBERS USED	
P1 — P4	CR3	DS3
CR1	R22	U3
	P5	



NOTES

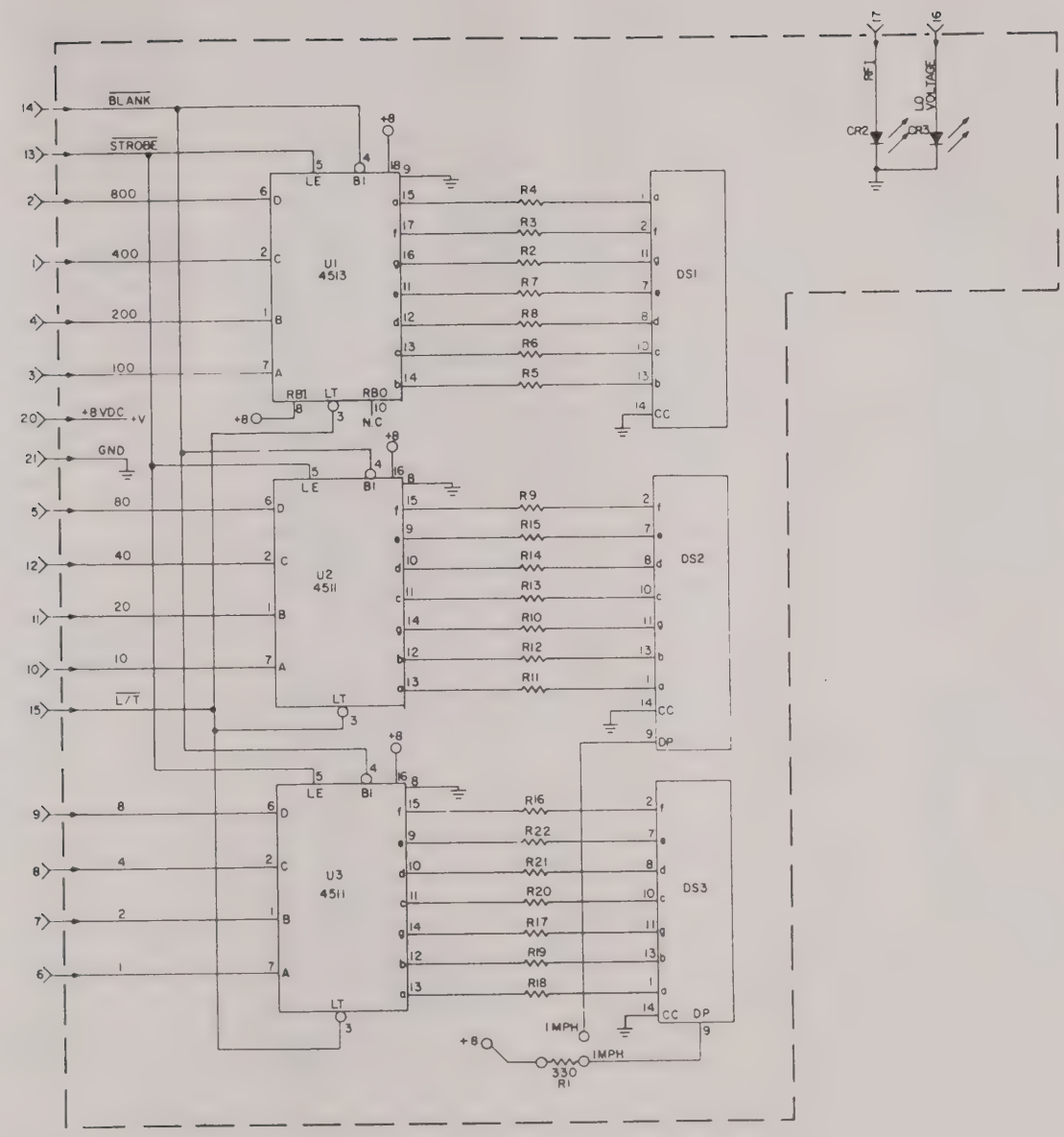
1. UNITS WITH A 200-5659 REV. 3 OR BELOW HAVE P5 MOUNTED ON THE COMPONENT SIDE. ALL OTHERS HAVE P5 MOUNTED ON THE SOLDER SIDE.

REF NO	DESCRIPTION	PART NO.
CR1	NOT USED	
CR2,3	DIODE LED RED RECTANGULAR	007-6057-00
DS1-3	LED DISPLAY HDSP-3733	037-0062-00
P5	CONN CARD 21 PIN	030-2076-21
PC1	DISPLAY PCB	009-5658-00
R1-22	RESISTOR C/F 330 OHM 1/4W 5%	130-0331-23
U1	IC 4513B	007-7437-00
U2,3	IC 4511 BDC/7 SEGMENT DECODER/DRIVER	007-7204-00

-02	0
-01	0
-00	0
EFF. ARTWORK	REV.

REVISIONS				
REV	ECO	DATE	BY	APP
0	REL	2/18/86	SD	
1	7484	2/18/86	SD	SH
2	7575	8/19/86	SB	SH

DRN JCV	DATE 5-83	KUSTOM QUALITY ELECTRONICS™
CHK Kull2	DATE 5/26/83	1010 W. Chestnut / Chanute, Kansas 66720 • 316/431-2700
ENG DWC	DATE 1-84	
TOLS. UNLESS NOTED: LINEAR: .XXX ±.005 .XX ±.01 .X ±.02 INCH: ± ANGLES: ±1° HOLES:		TITLE ASSEMBLY - DISPLAY BOARD, ROADRUNNER
		UNIT ROADRUNNER
SCALE 2:1	SHT 1 OF 1	P/N 300-5658-20 SIZE B



UNUSED REF. NUMBERS	HIGHEST REF. NUMBERS USED	
P1 – P4	CR3	DS3
CR1	R22	U3
	P5	

NOTES
1. ALL RESISTORS ARE 330 OHM, 1/4W, 5%
2. ALL PIN-OUTS REFER TO P5 – XX.

REVISIONS				
REV	ECO	DATE	BY	APP
0	REL	2/86	SD	
1	7484	2-18-86	SD	

-02	C
-01	0
-00	0
EFF ART WORK	REV

DRN JCV	DATE 5-89	KUSTOM ELECTRONICS
CHK	DATE	
ENG	DATE 1-24	
TOLS UNLESS NOTED: LINEAR .XXX ± .XX ± .X ± ANGLES ±1° HOLES .XXX ± .XX ±		TITLE SCHEMATIC - 3 DIGIT DISPLAY BOARD, ROADRUNNER
		UNIT ROADRUNNER
SCALE	SHT 1 OF 1	P/N 002-5658-20 SIZE C

ASSEMBLY NO: 200-0884-20
DESCRIPTION: FINAL ASSY ROADRUNNER
ASSY DWG NO: 300-0336-20

REF NO	DESCRIPTION	PART NO
1,2	ROADRUNNER HOUSING PAIR	200-0957-00
3	REAR DECAL ROADRUNNER	057-1247-00
4(S103,105)	SWITCH PUSHBUTTON BLK	031-0122-01
5(R101,S101)	RESISTOR VARIABLE 10K LIN W/SW	133-0091-00
6	KNOB CONTROL	090-0036-00
7	LOGIC BD ROADRUNNER	200-5656-20
8	SCREW FHP 4-40 X 5/16 NLP	089-5538-01
9	HORN W/WAVEGUIDE	200-0373-11
10	MOTHER BD ASSY TSTD	200-5659-00
11	SCREW PHP 6-32 X 3/8 SEMS	089-5028-06
12	DISPLAY BD ROADRUNNER	200-5658-20
13	SLIDE SPACER	076-0235-00
14	SCREW PHP 6-32 X 1/2	089-5062-08
15	TRIGGER BRKT ASSY	200-0890-00
16	SCREW THP 4-40 X 1/4	089-5881-04
17	NOT USED	
18(S102)	SWITCH PUSHBUTTON BLK	031-0122-01
19-21	NOT USED	
22	SCREW PHP 6-32 X 1/4 SEMS	089-5028-04
23	FILTER BD ROADRUNNER	200-5657-20
24	TRIGGER	088-0090-00
25	LENS READOUT RED	087-1055-08
26	O-RING	187-0109-00
27	NOT USED	
28	S/N TAG LO PWR SOURCE	057-1198-01
29	POP RIVET	092-0000-32
30	SCREW OHP 6-32 X 1 1/2 SS	089-5801-24
31	SCREW OHP 6-32 X 3/4 SS	089-5801-12
32	SCREW OHP 6-32 X 2 SS	089-5801-32
33	COVER ROADRUNNER	047-0979-08
34-40	NOT USED	
41	CABLE ASSY	155-2470-00

ASSEMBLY NO: 200-0890-00
DESCRIPTION: TRIGGER BRACKET ASSY
ASSY DWG NO: 300-0343-00

REF NO	DESCRIPTION	PART NO
1	TRIGGER BRKT W/FINISH	047-1159-04
2	NOT USED	
3(S104)	SWITCH TOGGLE 1P MOM	031-0061-00
4	WASHER INT TOOTH #1/4	089-8500-08
5(C103)	CAPACITOR F/T 1500 PF W/LEADS	106-0001-00
6(C102)	CAPACITOR M/C .1 µF 50V 10%	107-0001-35
7(C104)	CAPACITOR ELECT 1000 µF 16V	095-0024-15
8(CR103)	DIODE 1N5822	007-6079-02
9(R103)	RESISTOR W/W .1 OHM 5W 10%	132-0001-02
10	WIRE 22 GA TFE RED	025-0003-02
11	WIRE 22 GA TFE BLK	025-0003-00
12	POWER CABLE	155-2044-01
13	WIRE 22 GA TFE ORN	025-0003-03

ASSEMBLY NO: 155-2044-01
DESCRIPTION: FALCON/ROADRUNNER POWER CABLE

QTY	DESCRIPTION	PART NO
1	3 CONDUCTOR COILED CORD	025-0038-00
1	STRAIN RELIEF	090-0120-00
1	CIGARETTE LIGHTER PLUG W/FUSE	090-0314-00

ASSEMBLY NO: 200-0373-11
DESCRIPTION: HORN W/WAVEGUIDE ASSY
ASSY DWG NO: 300-0097-00

QTY	DESCRIPTION	PART NO
1	LENS	088-0091-00
4	SCREW PHP 4-40 X 3/8 SEMS	089-5026-06
1	DIODE MOUNT S/ASSY	200-0544-00
1	WAVEGUIDE SUB-ASSY	200-0695-10

ASSEMBLY NO: 200-0544-00
DESCRIPTION: DIODE MOUNT S/ASSY

QTY	DESCRIPTION	PART NO
1	MIXER DIODE	007-6034-00
1	DIODE MOUNT	073-0119-02
1	NUT 2-56	089-2004-21
1	SCREW PHP 2-56 X 3/8	089-5054-06
1	WASHER INT TOOTH #2	089-8500-00
1	CABLE ASSY MIXER DIODE	155-2045-00

ASSEMBLY NO: 155-2045-00
DESCRIPTION: CABLE ASSY MIXER DIODE

QTY	DESCRIPTION	PART NO
	COAX RG-188 AU	024-0001-00
1	3501 MC PHONO PLUG	030-1017-00
1	CHOKE	076-0225-01
1	FERRULE	076-0226-01
1	BUSHING JAM	076-0227-01
1	HEX NUT	089-2510-01
1	FELT WASHER	090-0187-00

ASSEMBLY NO: 200-0695-10
DESCRIPTION: WAVEGUIDE S/ASSY

QTY	DESCRIPTION	PART NO
1	#4 GROUND LUG	008-0000-01
2	FASTON TERMINAL .300	008-0002-00
1	LV OSCILLATOR K-BAND (SOURCE)	015-0045-00
1	HORN	047-0589-02
1	WAVEGUIDE ASSY	047-5064-02
1	TUNING STUB	076-0224-01
1	NUT 2-56	089-2004-21
1	NUT HEX 4-40 KEPS	089-2058-21
4	SCREW PHP 4-40 X 1/4 SEMS	089-5026-04
1	SCREW PHP 2-56 X 3/8	089-5054-06
1	WASHER INT TOOTH #2	089-8500-00

ASSEMBLY NO: 200-5657-20
DESCRIPTION: PREAMP/FILTER BD ROADRUNNER
ASSY DWG NO: 300-5657-20

REF NO	DESCRIPTION	PART NO
C1	CAPACITOR TANT 33 µF 10V 10%	096-1007-09
C2	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C3	CAPACITOR M/P .047 µF	106-0016-05
C4,5	CAPACITOR D/C .001 µF Z5F 20%	109-1021-16
C6-9	NOT USED	
C10	CAPACITOR MLR FLM .022 µF 100V	105-0035-12
C11	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C12	CAPACITOR D/C 33 PF X5F10%	109-3300-35
C13	CAPACITOR ELECT 10 µF 16V	095-0024-02
C14	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C15	CAPACITOR TANT 22 µF 10V 10%	096-1007-02
C16	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C17	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C18	CAPACITOR MLR FLM .001 µF 100V	105-0035-00
C19	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C20	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C21	CAPACITOR ELECT 100 µF 16V	095-0023-09
C22	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C23	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C24,25	NOT USED	
C26	CAPACITOR MLR FLM .068 µF 100V	105-0035-17
C27	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C28	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C29	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C30	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C31	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C32	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C33,34	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C35	CAPACITOR ELECT 100 µF 16V	095-0023-09
C36	CAPACITOR M/P 1 µF	106-0016-03
C37	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C38	CAPACITOR D/M 120 PF 100V 5%	100-0000-28
C39	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C40	CAPACITOR MLR FLM .033 µF 100V	105-0035-13
C41	CAPACITOR MLR FLM .0047 µF 100V	105-0035-05
C42	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C43	NOT USED	
C44	CAPACITOR MLR FLM .1 µF 100V	105-0035-09
C45-47	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C48	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C49	CAPACITOR M/P 1 µF	106-0016-04
C50	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C51	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C52	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C53	CAPACITOR TANT 4.7 µF 10V10%	096-1010-01
C54	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C55	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C56-58	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46

REF NO	DESCRIPTION	PART NO
CR1,2	DIODE 1N4148	007-6016-00
HW1	SPACER PC BD	076-0005-03
HW2	BUSS WIRE #22	025-1000-00
HW3	KYNAR WIRE 30 GA SIL/PL	025-1006-01
J1U	PHONO JACK PC MTG	030-1019-00
L1	INDUCTOR 18 UH	019-2015-21
P3	CONN CARD 4 PIN	030-2076-04
PC1	PC BD PREAMP/FILTER	009-5657-00
Q1	NOT USED	
Q2,3	TRANSISTOR 2N5088	007-0020-00
Q4	TRANSISTOR 2N5086	007-0021-00
Q5	TRANSISTOR 2N3567	007-0005-00
R1	RESISTOR C/F 270 OHM 1/4W 5%	130-0271-23
R2	RESISTOR MFLM 97.6K 1/8W 1%	125-9762-01
R3	RESISTOR MFLM 150K 1/8W1%	125-1503-01
R4	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R5-11	NOT USED	
R12	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R13	RESISTOR C/F 3.3 MEG 1/4W 5%	130-0335-23
R14	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R15	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R16	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R17	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R18	RESISTOR MFLM 49.9K 1/8W 1%	125-4992-01
R19	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R20	RESISTOR MFLM 10 OHM 1/8W 1%	125-0100-01
R21	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R22	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R23	RESISTOR MFLM 8.25K 1/8W 1%	125-8251-01
R24	RESISTOR MFLM 2.05K 1/8W 1%	125-2051-01
R25	RESISTOR MFLM 221 OHM 1/8W 1%	125-2210-01
R26	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R27	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R28	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R29	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R30	NOT USED	
R31	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R32	RESISTOR C/F 220K 1/4W 5%	130-0224-23
R33	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R34	NOT USED	
R35	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R36	RESISTOR MFLM 2.55K 1/8W 1%	125-2551-01
R37	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R38,39	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R40	RESISTOR MFLM 36.5K 1/8W 1%	125-3652-01
R41	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R42	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R43	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R44	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R45-47	RESISTOR MFLM 4.99K 1/8W 1%	125-4991-01
R48	RESISTOR MFLM 127K 1/8W 1%	125-1273-01
R49	RESISTOR MFLM 100K 1/8W 1%	125-1003-01

REF NO	DESCRIPTION	PART NO
R50	RESISTOR C/F 150K 1/4W 5%	130-0154-23
R51,52	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R53	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R54	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R55	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R56,57	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R58	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R59	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R60	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R61	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R62	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R63	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R64	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R65	RESISTOR C/F 47K 1/4W 5%	130-0473-23
U1	NOT USED	
U2	IC 393 VOLT COMP	007-7225-00
U3	IC 4558 DUAL OP AMP	007-7201-00
U4	IC 4070B QUAD 2-INPUT XOR	007-7257-00
U5,6	IC 4558 DUAL OP AMP	007-7201-00
U7	IC 393 VOLT COMP	007-7225-00
U8	IC 3280 XCNDCT AMP	007-7286-00

ASSEMBLY NO: 200-5657-21
DESCRIPTION: PREAMP/FILTER BD ROADRUNNER
ASSY DWG NO: 300-5657-21

REF NO	DESCRIPTION	PART NO
C1	CAPACITOR TANT 33 µF 10V 10%	096-1007-09
C2	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C3	CAPACITOR M/P .047 µF	106-0016-05
C4,5	CAPACITOR D/C .001 µF Z5F 20%	109-1021-16
C6,7	CAPACITOR MLR FLM .0068 µF 100V	105-0035-07
C8	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C9	CAPACITOR MLR FLM .0022 µF 100V	105-0035-02
C10	CAPACITOR MLR FLM .022 µF 100V	105-0035-12
C11	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C12	CAPACITOR D/C 33 PF X5F10%	109-3300-35
C13	CAPACITOR ELECT 10 µF 16V	095-0024-02
C14	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C15	CAPACITOR TANT 22 µF 10V 10%	096-1007-02
C16	CAPACITOR D/C 47 PF N750 5%	110-4700-34
C17	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C18	CAPACITOR MLR FLM .001 µF 100V	105-0035-00
C19	CAPACITOR D/C 10 PF N750 5%	110-1000-34
C20	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C21	CAPACITOR ELECT 100 µF 16V	095-0023-09
C22	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C23	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C24	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C25	CAPACITOR M/P 1 µF	106-0016-03
C26	CAPACITOR MLR FLM .068 µF 100V	105-0035-17
C27	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C28	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C29	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C30	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C31	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C32	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C33,34	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C35	CAPACITOR ELECT 100 µF 16V	095-0023-09
C36	CAPACITOR M/P 1 µF	106-0016-03
C37	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C38	CAPACITOR D/M 120 PF 100V 5%	100-0000-28
C39	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C40	CAPACITOR MLR FLM .033 µF 100V	105-0035-13
C41	CAPACITOR MLR FLM .0047 µF 100V	105-0035-05
C42	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C43	NOT USED	
C44	CAPACITOR MLR FLM .1 µF 100V	105-0035-09
C45-47	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C48	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C49	CAPACITOR M/P 1 µF	106-0016-04
C50	CAPACITOR D/C 33 PF X5F 10%	109-3300-35
C51	CAPACITOR TANT 4.7 µF 10V 10%	096-1010-01
C52	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C53	CAPACITOR TANT 4.7 µF 10V10%	096-1010-01

REF NO	DESCRIPTION	PART NO
C54	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C55	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C56-58	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
CR1-6	DIODE 1N4148	007-6016-00
HW1	SPACER PC BD	076-0005-03
HW2	BUSS WIRE #22	025-1000-00
HW3	KYNAR WIRE 30 GA SIL/PL	025-1006-01
J10	PHONO JACK PC MTG	030-1019-00
L1	INDUCTOR 18 UH	019-2015-21
P3	CONN CARD 4 PIN	030-2076-04
PC1	PC BD PREAMP/FILTER	009-5657-00
Q1	TRANSISTOR JFET J110	007-0090-00
Q2,3	TRANSISTOR 2N5088	007-0020-00
Q4	TRANSISTOR 2N5086	007-0021-00
Q5	TRANSISTOR 2N3567	007-0005-00
R1	RESISTOR C/F 270 OHM 1/4W 5%	130-0271-23
R2	RESISTOR MFLM 97.6K 1/8W 1%	125-9762-01
R3	RESISTOR MFLM 150K 1/8W1%	125-1503-01
R4	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R5	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R6	RESISTOR C/F 47 OHM 1/4W 5%	130-0470-23
R7	RESISTOR C/F 6.8K 1/4W 5%	130-0682-23
R8	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R9-11	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R12	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R13	RESISTOR C/F 3.3 MEG 1/4W 5%	130-0335-23
R14	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R15	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R16	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R17	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R18	RESISTOR MFLM 49.9K 1/8W 1%	125-4992-01
R19	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R20	RESISTOR MFLM 10 OHM 1/8W 1%	125-0100-01
R21	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R22	RESISTOR MFLM 10K 1/8W 1%	125-1002-01
R23	RESISTOR MFLM 8.25K 1/8W 1%	125-8251-01
R24	RESISTOR MFLM 2.05K 1/8W 1%	125-2051-01
R25	RESISTOR MFLM 221 OHM 1/8W 1%	125-2210-01
R26	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R27	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R28	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R29	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R30	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R31	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R32	RESISTOR C/F 220K 1/4W 5%	130-0224-23
R33,34	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R35	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R36	RESISTOR MFLM 2.55K 1/8W 1%	125-2551-01
R37	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R38,39	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R40	RESISTOR MFLM 36.5K 1/8W 1%	125-3652-01
R41	RESISTOR C/F 22K 1/4W 5%	130-0223-23

REF NO	DESCRIPTION	PART NO
R42	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R43	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R44	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R45-47	RESISTOR MFLM 4.99K 1/8W 1%	125-4991-01
R48	RESISTOR MFLM 127K 1/8W 1%	125-1273-01
R49	RESISTOR MFLM 100K 1/8W 1%	125-1003-01
R50	RESISTOR C/F 150K 1/4W 5%	130-0154-23
R51,52	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R53	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R54	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R55	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R56,57	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R58	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R59	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R60	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R61	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R62	RESISTOR C/F 22K 1/4W 5%	130-0223-23
R63	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R64	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R65	RESISTOR C/F 47K 1/4W 5%	130-0473-23
U1	IC 4558 DUAL OP AMP	007-7201-00
U2	IC 393 VOLT COMP	007-7225-00
U3	IC 4558 DUAL OP AMP	007-7201-00
U4	IC 4070B QUAD 2-INPUT XOR	007-7257-00
U5,6	IC 4558 DUAL OP AMP	007-7201-00
U7	IC 393 VOLT COMP	007-7225-00
U8	IC 3280 XCNDCT AMP	007-7286-00

ASSEMBLY NO: 200-5656-20
DESCRIPTION: LOGIC BD ROADRUNNER
ASSY DWG NO: 300-5656-20

REF NO	DESCRIPTION	PART NO
C1,2	CAPACITOR ELECT 100 µF 16V	095-0023-09
C3,4	CAPACITOR D/M 47 PF 300V 5%	100-0003-14
C5	CAPACITOR D/C .05 µF Z5T	109-5034-67
C6	NOT USED	
C7	CAPACITOR M/P .22 µF	106-0016-01
C8	CAPACITOR MLR FLM .001 µF 100V	105-0035-00
C9	CAPACITOR MLR FLM .015 µF 100V	105-0035-10
C10	CAPACITOR ELECT 100 µF 16V	095-0023-09
C11	CAPACITOR MLR FLM .1 µF 100V	105-0035-19
C12	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C13	CAPACITOR M/P .47 µF	106-0016-02
C14,15	CAPACITOR D/M 47 PF 300V 5%	100-0003-14
C16	CAPACITOR ELECT 2.2 µF 35V	096-0023-08
C17	CAPACITOR ELECT 1 µF 35V	095-0023-00
C18-20	CAPACITOR D/C .01 µF Z5V 20%	109-1030-46
C21	CAPACITOR MLR FLM .0047 µF 100V	105-0035-05
C22	CAPACITOR M/P .1 µF	106-0016-00
CJ1	CIRCUIT JUMPER	090-0270-00
CR1-6	DIODE 1N4148	007-6016-00
CR7	NOT USED	
CR8,9	DIODE 1N4148	007-6016-00
HW1	SPACER PC BD	076-0005-03
HW2	FISH PAPER WASHER	012-0006-30
HW3	WIRE 26 GA TFE CW RED	025-0006-22
HW4	WIRE 26 GA TFE CW BLK	025-0006-00
P1-3	NOT USED	
P4	CONN CARD 26 PIN	030-2076-26
PC1	LOGIC PC BD	009-5656-00
Q1,2	TRANSISTOR 2N3567	007-0005-00
R1	RESISTOR C/F 560 OHM 1/4W 5%	130-0561-23
R2	RESISTOR C/F 1.8K 1/4W 5%	130-0182-23
R3	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R4	RESISTOR C/F 1.2K 1/4W 5%	130-0122-23
R5,6	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R7,8	NOT USED	
R9	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R10	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R11	RESISTOR C/F 1.5 MEG 1/4W 5%	130-0155-23
R12	RESISTOR C/F 33K 1/4W 5%	130-0333-23
R13	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R14	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R15	RESISTOR C/F 10 OHM 1/4W 5%	130-0100-23
R16	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R17	RESISTOR C/F 4.7K 1/4W 5%	130-0472-23
R18	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R19	RESISTOR C/F 680K 1/4W 5%	130-0684-23
R20	RESISTOR C/F 1.2K 1/4W 5%	130-0122-23
R21	RESISTOR C/F 3.3 MEG 1/4W 5%	130-0335-23
R22	RESISTOR C/F 2.2 MEG 1/4W 5%	130-0225-23

REF NO	DESCRIPTION	PART NO
R23	RESISTOR C/F 10K OHM 1/4W 5%	130-0103-23
R24	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R25,26	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R27,28	RESISTOR C/F 100K 1/4W 5%	130-0104-23
R29	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R30	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R31	NOT USED	
R32	RESISTOR C/F 6.8K 1/4W 5%	130-0682-23
R33	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23
R34	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R35	RESISTOR C/F 10K 1/4W 5%	130-0103-23
SPKR	SPEAKER 1 1/2 INCH	038-0114-00
U1	IC 4069 HEX INV UNBUF	007-7238-00
U2	IC 74C14 HEX SCHMITT TRIGGER	007-7207-00
U3,4	NOT USED	
U5	IC 4001 QUAD 2-INPUT NOR	007-7187-00
U6	IC 4023 TRIPLE 3-INPUT NAND	007-7170-00
U7	IC 4011 QUAD 2-INPUT NAND	007-7163-00
U8	IC 4538 DUAL MONO	007-7255-00
U9	IC 4060 BINARY COUNTER/DIVIDER	007-7253-00
U10	IC 4520 DUAL BINARY UP CNTR	007-7206-00
U11	IC 4013 DUAL D FLIP-FLOP	007-7165-00
U12	IC 4518 DUAL BCD UP CNTR	007-7205-00
U13	IC 4011 QUAD 2-INPUT NAND	007-7163-00
U14	IC 4518 DUAL BCD UP CNTR	007-7205-00
U15	IC 4020 BINARY COUNTER	007-7168-00
U16	IC 4046 PLL	007-7190-00
U17	IC 4013 DUAL D-FLIP-FLOP	007-7165-00
U18	IC 4011 QUAD 2-INPUT NAND	007-7163-00
Y1	CRYSTAL 1.180024 MHZ	044-0000-15
Y2	CRYSTAL 1.184651 MHZ	044-0000-17

ASSEMBLY NO: 200-5659-00
DESCRIPTION: MOTHER BD FALCON, ROADRUNNER
ASSY DWG NO: 300-5659-00

REF NO	DESCRIPTION	PART NO
C1,2	CAPACITOR ELECT 10 µF 25V	095-0023-01
C3	CAPACITOR ELECT 100 µF 16V	095-0023-09
C4	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C5	CAPACITOR D/C 470 PF X5F 10%	109-4710-35
C6	CAPACITOR ELECT 100 µF 16V	095-0023-09
C7-11	CAPACITOR MLR FLM .01 µF 100V	105-0035-09
C12	CAPACITOR D/C 10 PF X5F 10%	109-1000-35
CR1	DIODE 1.5KE8.2A VOLT SUPR	007-5067-06
CR2	DIODE 1N5226B	007-5085-05
CR3,4	DIODE 1N4148	007-6016-00
CR5,6	DIODE 1N4148 PAIR ASSY	007-6096-00
HW1	NOT USED	
HW2	BRKT TRANS W/HW	047-1890-00
HW3	NUT HEX 4-40 KEPS	089-2058-21
HW4	SCREW PHP 6-32 X 3/8 SEMS	089-5028-06
HW5	SCREW PHP 4-40 X 1/4	089-5058-04
HW6	WASHER NYLON	090-0004-00
HW7	MICA INSULATOR	090-0170-00
HW8	SPACER .450 X .250 6-32	076-0001-23
HW9	SCREW PHP 4-40 X 5/16	089-5058-05
J1,2	FASTON TERM TAB .250	008-0028-02
J3	CONTACT STRIP 4 PIN	030-2078-04
J4	CONTACT STRIP 26 PIN	030-2078-26
J5	CONTACT STRIP 21 PIN	030-2078-21
J6	POST HEADER 8 PIN	030-2144-06
L1	INDUCTOR 18 µH	019-2015-21
PC1	PCB MOTHER BD	009-5659-00
Q1-5	TRANSISTOR 2N3567	007-0005-00
Q6	TRANSISTOR MJE-3055T	007-0083-00
R1	RESISTOR C/F 2.2K 1/4W 5%	130-0222-23
R2	RESISTOR C/F 1K 1/4W 5%	130-0102-23
R3	POT 1K 1T 10% 3386Y	133-0103-02
R4,5	RESISTOR C/F 560 OHM 1/4W 5%	130-0561-23
R6	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R7	RESISTOR .18 OHM 3W 10%	132-0001-09
R8	RESISTOR C/F 2.2K 1/4W 5%	130-0222-23
R9	RESISTOR MFLM 2.8K 1/8W 1%	125-2801-01
R10	RESISTOR MFLM 60.4K 1/8W1%	125-6042-01
R11	RESISTOR C/F 6.8K 1/4W 5%	130-0682-23
R12	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R13-16	RESISTOR C/F 330 OHM 1/4W 5%	130-0331-23
R17,18	RESISTOR C/F 10K 1/4W 5%	130-0103-23
R19	RESISTOR C/F 2.2K 1/4W 5%	130-0222-23
R20	RESISTOR MFLM 68.1K 1/8W 1%	125-6812-01
R21	RESISTOR C/F 270 OHM 1/4W 5%	130-0271-23
R22	RESISTOR C/F 1 MEG 1/4W 5%	130-0105-23

200-5659-00

REF NO	DESCRIPTION	PART NO
R23	RESISTOR MFLM 33.2K 1/8W 1%	125-3572-01
R24,25	RESISTOR C/F 47K 1/4W 5%	130-0473-23
R26	RESISTOR C/F 220 OHM 1/4W 5%	130-0221-23
U1	IC 723 VOLT REG DIP ADJ	007-7013-00
U2	IC 4011 QUAD 2-INPUT NAND	007-7163-00
U3	IC 393 VOLT COMP	007-7225-00
U4	IC 340T-8 VOLT REG	007-7150-24

ASSEMBLY NO: 200-5658-20
DESCRIPTION: ROADRUNNER DISPLAY BD
ASSY DWG NO: 300-5658-20

REF NO	DESCRIPTION	PART NO.
CR1	NOT USED	
CR2,3	DIODE LED RED RECTANGULAR	007-6057-00
DS1-3	LED DISPLAY HDSP-3733	037-0062-00
P5	CONN CARD 21 PIN	030-2076-21
PC1	DISPLAY PCB	009-5658-00
R1-22	RESISTOR C/F 330 OHM 1/4W 5%	130-0331-23
U1	IC 4513B	007-7437-00
U2,3	IC 4511 BDC/7 SEGMENT DECODER/DRIVER	007-7204-00

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MP MASTER
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